INTERAVIA

REVIEW OF WORLD AVIATION

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Into Battle by Air

VOLUME XII 2 FEBRUARY 1957

MONEYMAKER!

Lockheed, long famous with airlines throughout the world for producing moneymakers, now offers the all-new Turbo-prop Lockheed Electra. The Electra fulfills the airlines' growing need for transports that can operate economically over the majority of the world's air routes.

MONEYMAKING AND MONEYSAVING FEATURES

- Range Flexibility — 100 to 3,000 mile distances flown with unequalled economy from large and small airports . . . minimizes fleet requirements.
- Cruising speeds 60 miles per hour faster than any Turbo-prop airliner now flying.
- Unsurpassed styling, comfort, luxury and spaciousness for all classes of airline traffic.
- 30 percent lower fuel costs than latest piston-engine airliners due to aerodynamic cleanness of the Electra and relatively inexpensive fuels required for turbine-powered aircraft.
- Design innovations which minimize ground handling and maintenance requirements. This shortens ground-time for faster schedules. The Lockheed Electra means faster flight schedules, greater utilization and increased profits.

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128 ELECTRAS *have been ordered by American Airlines / Braniff International Airways / Eastern Air Lines KLM Royal Dutch Airlines / National Airlines / Western Air Lines.*

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INTERAVIA

Review of World Aviation

Volume XII **No. 2** **February 1957**

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Front Cover:

The first production models of the Lockheed C-130A *Hercules* tactical transport were delivered to the 463rd Troop Carrier Wing at Ardmore AFB, Oklahoma, at the end of 1956.

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2 major international routes
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38,000 flying hours per year, covering more than 7½ million miles

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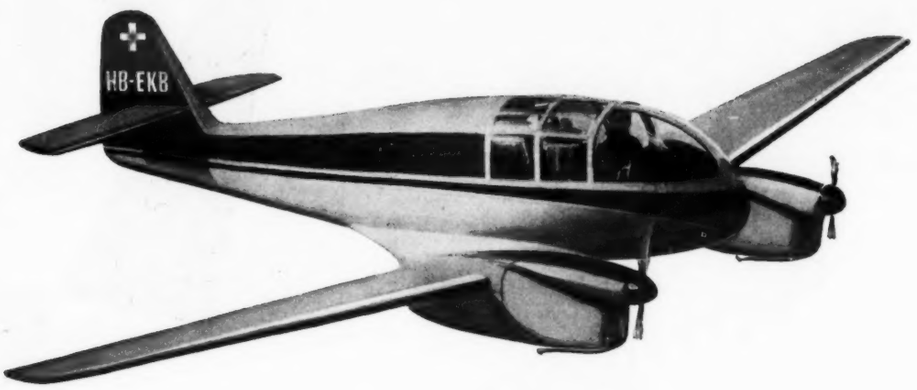

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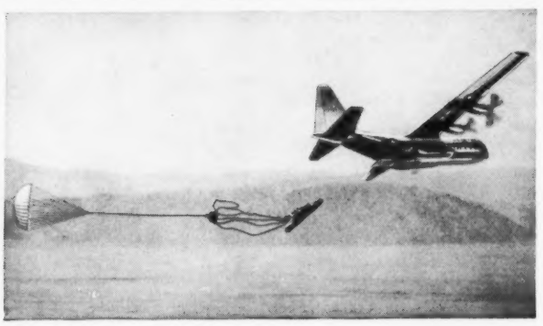

NEW "FLYING WORKHORSE" JOINS USAF

First Delivery of Lockheed C-130 Hercules with Allison Turbo-Prop Power

It can take aboard a 5,000-gallon fuel tank and tractor.

It can carry 60 to 90 fully equipped combat troops — and land on small, hastily prepared fields close to combat areas.

It can airlift up to 20 tons of cargo swiftly and efficiently — and make parachute drops for on-the-spot aerial delivery.

It's the great new "workhorse" of the Air Force—Lockheed's versatile C-130 Hercules—now being delivered to the Tactical Air Command's 18th Air Force at Ardmore Air Force Base, Oklahoma.

Powered by four 3,750-horsepower Allison T56 Turbo-Prop engines driving three-bladed Aeroproducts Turbo-Propellers, the C-130 attains speeds of over 350 miles per hour—more than 100 miles per hour faster than other tactical transports. *And it does this at less than half the ton-mile cost of its nearest competitor.*

A commercial version of the T56—Allison's Model 501 Turbo-Prop engine powering the new Lockheed Electra—will bring jet-age speed and luxury to commercial service, with new smoothness and quiet on flights now serving 98% of the nation's commercial passenger traffic. 128 of these new luxury airliners have been ordered by six major airlines.

This great new concept in aircraft power reflects Allison's unmatched experience in the design and development of aircraft turbine engines and turbo-propellers.

ALLISON DIVISION OF GENERAL MOTORS—Indianapolis, Indiana

ALLISON
TURBO-PROP POWER

VERSATILE POWER FOR JET-AGE FLIGHT

Around the World

B-52s SET FLIGHT RECORDS—Flying nonstop missions of up to 17,000 miles, eight Boeing B-52s of the U. S. Air Force's Strategic Air Command have set new distance and duration records for aircraft of their type. The B-52s, which flew continuously for periods of up to 32 ½ hours, each have eight Pratt & Whitney J-57 jet engines. Engines of this type will power jet transports ordered by the world's leading airlines. Four B-52s flew from a base on the West Coast of the U. S., four from a base on the East Coast. They passed over the North Pole and returned to land in the United States. The B-52 can fly at altitudes of over 50,000 feet, and has a maximum speed of over 650 miles per hour.

NEW HELICOPTER SPEED RECORD

A twin-engined Sikorsky HR2S of the U.S. Marine Corps has established a new international speed record for helicopters of 162.7 miles per hour. This exceeded a record set in 1954 at 156 miles per hour by a Sikorsky XH-39 with a turbine engine. The HR2S also set two records carrying specific payloads, excluding fuel and crew, to altitude in the trials, all subject to confirmation by the Fédération Aéronautique Internationale. These records are flying to more than 12,000 feet while carrying 5,000 kilograms, for a first-time record, and carrying 6,000 kilograms to an altitude of 7,000 feet, exceeding a previous Soviet mark of 4,000 kilograms to 6,560 feet.

with United Aircraft

FOR DENMARK — The Royal Danish Air Force will soon be flying a new fleet of seven Sikorsky S-55s, primarily in air-sea rescue missions. This same type of helicopter is flown by 18 nations of the Free World. In commercial versions it has inaugurated scheduled passenger service in Europe and America.

NEW PROPELLERS ON 1649A CONSTELLATIONS New hollow aluminium propeller blades, selected for Lockheed 1649A Constellations on order by Lufthansa and Trans World Airlines, offer important savings in weight. The weight saving in the Constellation's new propeller blades is equal to that of four additional passengers. Made by Hamilton Standard, the blade has been under development for the past six years. It has also been selected for use on KLM's new Lockheed Electra turboprop transports. The blade is partially filled with a synthetic sponge compound for additional support and is protected from abrasion and erosion damage by an exterior coating of nickel plate. It absorbs more horsepower per pound of weight than any other type in propeller history.

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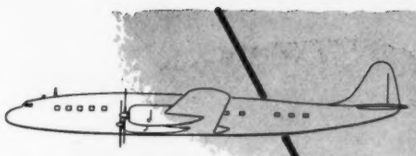
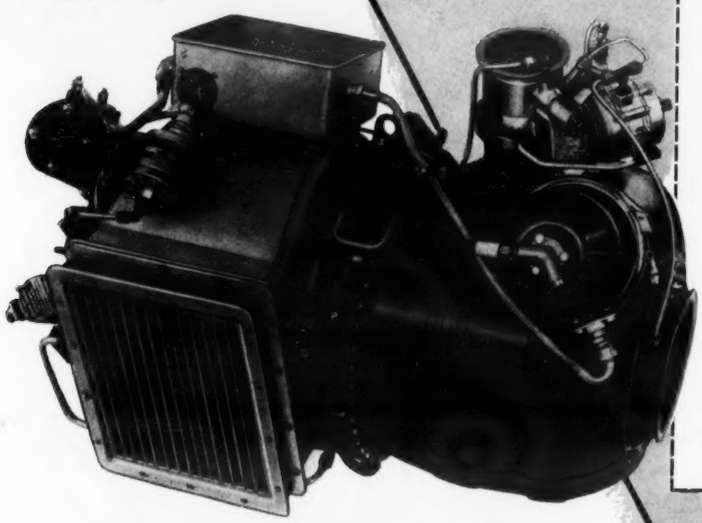


in the air...



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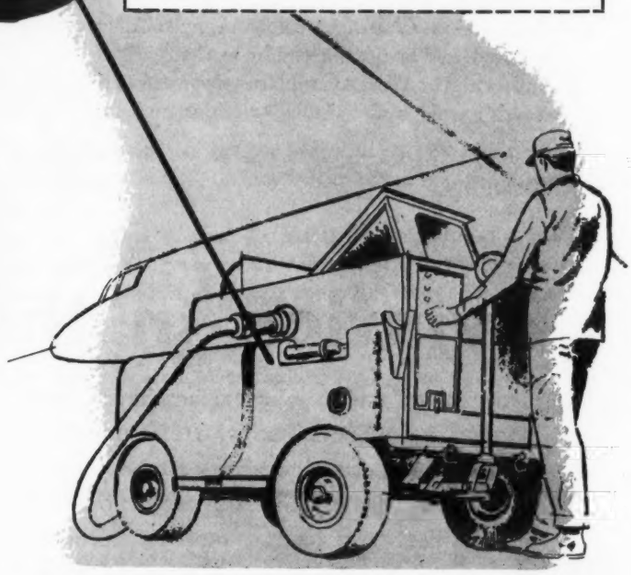
- ★ provide cabin or compartment air conditioning
- ★ push button starting
- ★ operate at ambient temperatures from −65F. to +130F.
- ★ long service life between overhauls
- ★ run on jet fuel or gasoline

or on the ground...

auxiliary power



The gas turbine shown is an illustration of the capability of AiResearch in this field. In the past ten years the company has produced more than 45,000 high-speed turbomachinery products which have performed efficiently during more than thirty-three million hours of operation.

You are invited to write for more specific information on our products and the addresses of AiResearch licensees throughout the European continent, the United Kingdom and Japan.

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Personally speaking

—a series of contributions on questions of the hour by leading aviation personalities.

AIR VICE-MARSHAL SIR LEONARD ISITT, K.B.E.,

Chairman New Zealand National Airways Corporation, Chairman Tasman Empire Airways Limited, and one of the leading world authorities on Civil Aviation development in the South Pacific, makes this contribution on . . .

Aviation in the South Pacific

Geographical and sociological facts have shaped aviation in the South Pacific. Its future will be influenced by certain governing factors peculiar to this area: the terrain makes airport development difficult and costly ; most territories are isolated from each other by vast ocean distances ; the general population density is low and the potential travelling population limited. But these factors, together with growing population, expanding trade, inevitably increasing development of native peoples, are today creating ever greater demands for the air transportation of mails, passengers and cargo.

South Pacific aviation will always have its special problems which are, however, a spur rather than a brake because the circumstances which create special difficulties also make aeronautical development vital to everyone who lives between Easter Island and the Commonwealth of Australia.

During the coming decade our civil air resources will be called on to meet a swelling demand for air transportation within, and to and from our area. During the last two decades we have established traditions, standards and skills upon which shall be built the future of aviation for the South Pacific—immediately destined, as it is, to provide closer communication with the world, whether communication is by letters and cargoes, or by peoples and ideas.

AVIATION BP SERVICE

serves aviation well

THE BRITISH PETROLEUM COMPANY LIMITED

THE ERA OF THE ELAND IS BEGINNING...

The case for ELAND conversion

To forward-looking operators of medium-haul airlines the base for ELAND conversion becomes clearer and more convincing month by month. Increasingly they see that ELANDS point the way to the achievement of better performance, greater earning capacity, and greater dependability in service from well-proven airframes.

No beat, whine or whistle

ELANDS possess to the full that inherent asset of the turbo-prop—a greatly reduced noise level. And over and above this they have an inherent asset of their own—a complete absence of beat, whine or whistle. The passenger appeal implicit in this needs no emphasis.

Flexibility of power

ELAND design provides a wide range of power in a one-sized package. The 3,000-4,200 e.h.p. range of ELAND engines differ nothing in size and only little in overall weight. This flexibility will enable operators to standardize on one basic engine and nacelle design where two or three different types of piston engines are now required.

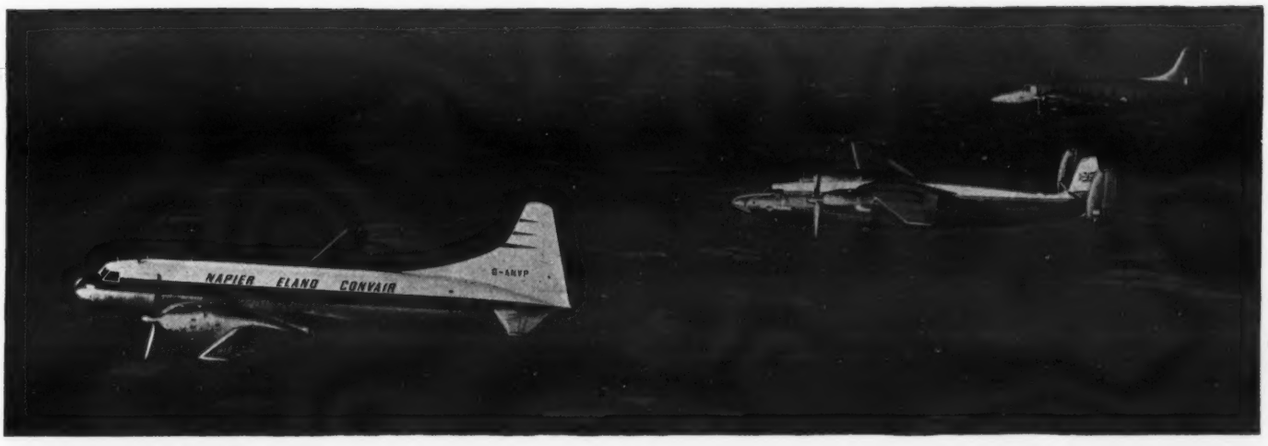
Conversion of the Convair 340

The Napier Eland Convair—a Convair 340 which we bought from the makers and converted to ELANDS—has proved the simplicity of ELAND installation, the low cost of conversion and the increased profits that accrue from ELAND operation.

From studies made of the published direct operating costs (including depreciation) of a number of typical airlines, it is proved that in the light of our guarantees a converted aircraft will be cheaper to operate—whether the costs are calculated on the basis of aircraft miles, ton miles or passenger miles. The ELAND-engined Convair 340 can carry its maximum payload 930 miles further than piston-engined Convairs, and its cruising speed is 50 m.p.h. higher.

In short, we offer to operators of the Convair—and other medium-haul 'planes—an airliner with a new lease of life at a cost which will be written off over a relatively short period. That is the essence of the case for ELAND conversion.

Eland conversion means increased profits to the progressive airline



Three examples of successful Napier Eland conversions: the Convair 340, the Elizabethan, the Varsity

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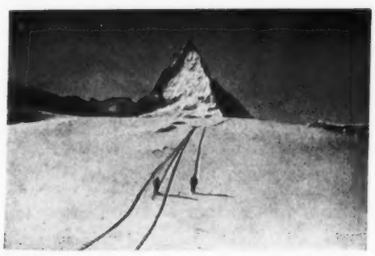
For your winter sports holiday

Geneva international airport occupies a key position in relation to the winter sports centres in Valais and Savoy. By flying to Geneva you save time and prolong your winter holiday. Special direct services to the French centres.

Ready for the Races in the Alpes vaudoises.

Oh boy ! What a view on the Mont-Blanc (highest peak in Europe) and the French Alps. Shot from the Swiss Jura.



Can you imagine how happy these two people feel ? The " Suger cake " is the Matterhorn (Alpes valaisannes).

On the sunny side of good old Earth. This train will take you right into the heart of the Jungfrau (Bernese Oberland).

And here is the way to climb a mountain without getting tired. In front of the majestic Mont-Blanc, French Savoy.

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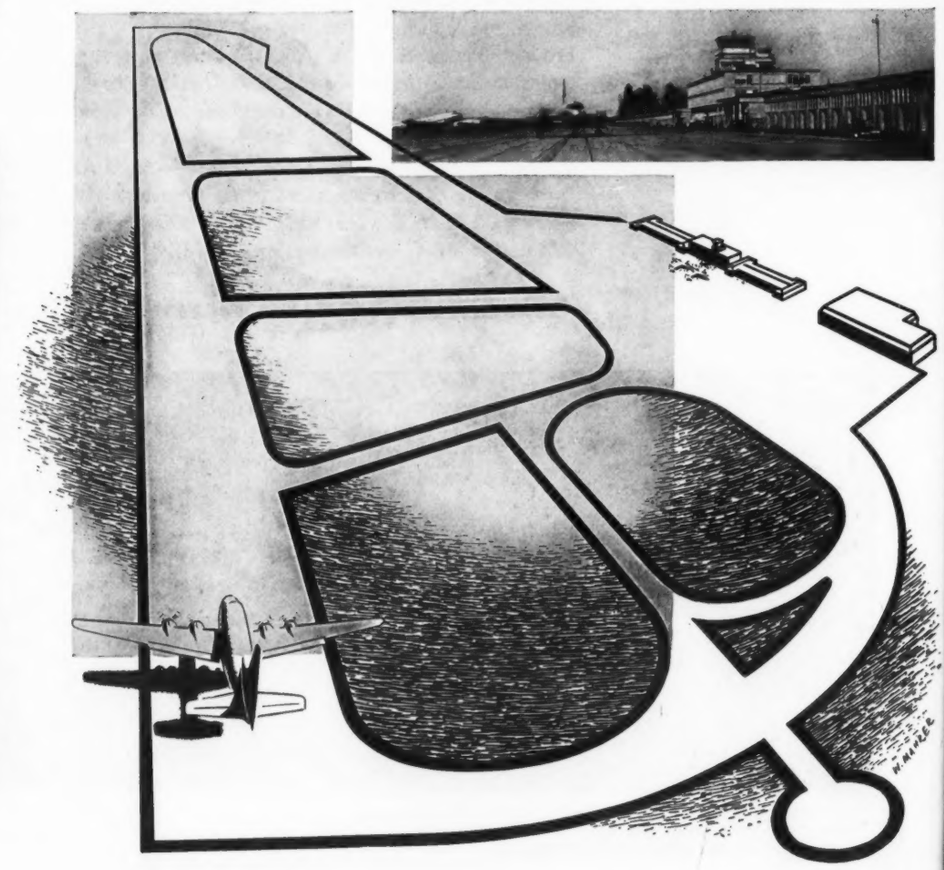
INTERNATIONAL AVIATION CENTRE



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"Radar... meteorologists' most important new instrument since they commenced to use aeroplanes"

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R2

100 airline pilots have tested the Boeing jet transport

When the Boeing 707 jet transport begins carrying passengers early in 1959, it will be the most intensively proven aircraft type ever to enter commercial service.

Already behind it are more than two years of exhaustive flight testing. This includes tests by commercial pilots who will be flying the 707. To get their reactions, Boeing invited 100 pilots from airlines around the globe to put the 707 through its paces.

At the start of each flight, Boeing's test pilot waved one of the airline pilots into the captain's seat and said: " Take it away. She's all yours. " They put the craft through maneuvers that tested every flight characteristic. They did dives, stalls, high speed and low speed maneuvers, and flew with two engines on the same side shut off.

The pilots' reports were uniformly enthusiastic. A typical report: " Almost incredibly simple to manipulate and easy to fly ". And another: " The flight was easily the most exhilarating of my flying career, and I'll include my solo in this statement ". Another pilot reported: " Control is firm and prompt from hard over aileron at 600 mph down to slow speed flight ".

The Boeing 707 impressed the airline pilots with its easy handling, its amazing performance, its quiet, vibration-free ride—and the simplicity of its controls—115 *fewer* than in some conventional airliners. In summing up reactions, another pilot concluded: " The 707 generated in me a feeling of complete confidence and reliability. Its performance is superb. For the airline pilot, the 707 marks a new, brighter era—something he has dreamed about ". And another echoed the same sentiments: " Airline pilots are going to love these swept-wing, high-performance ' squirters ' ".

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THE FIRST VERSATILE TURBOPROP AIRLINER FOR SHORT AND MEDIUM RANGE TRAFFIC ANYWHERE IN THE WORLD, POWERED BY THE WORLD'S MOST RELIABLE PROPELLER-TURBINE, THE FAMOUS 1600 SHP ROLLS-ROYCE "DART"

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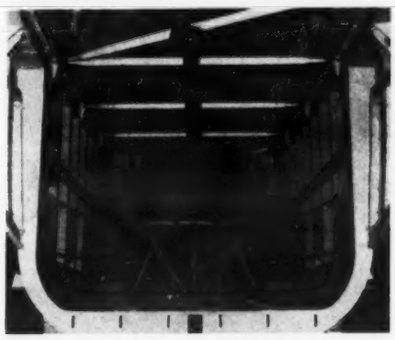
Deux-Ponts

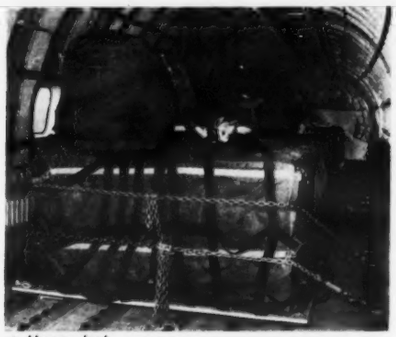
Military transport and heavy parachuting

LOADING EXAMPLES

- 1 14-ton A.M.X. TANK
- 3 LIGHT INTERCEPTORS, type Breguet 1100
- 2 105-mm GUNS
  2 DODGES
  22 MEN and ammunition
- 6 105-mm GUNS
- 8 JEEPS or cross-country vehicles
- 4 G.M.C. TRUCKS
- 164 TROOPS and equipment

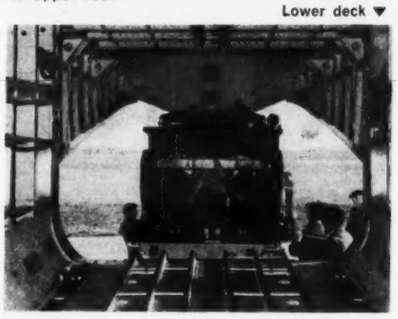


Loading a 14-ton A.M.X. tank
+ 3 tons of ammunition



▲ Upper deck

Lower deck ▼



The BREGUET Deux-Ponts
can carry a total of **17 tons** of payload for parachuting

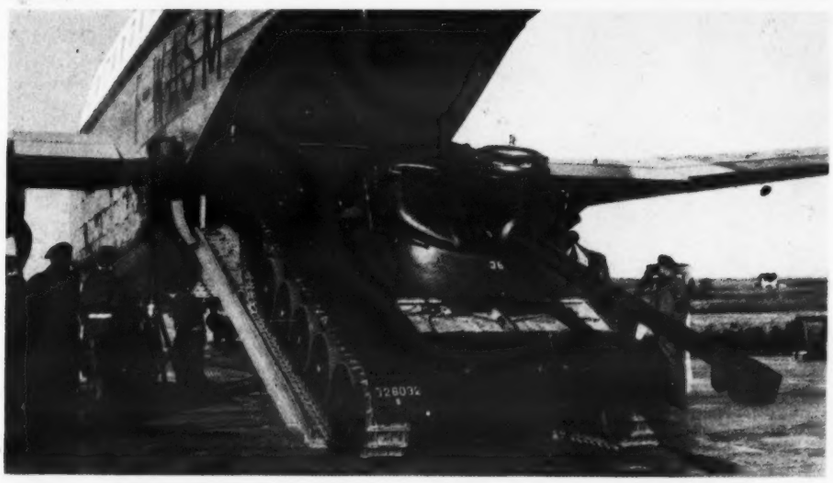
Unloading an A.M.X. tank
under its own power on special ramps carried aboard

HEAVY PARACHUTING

Upper deck
9 one-ton containers

Lower deck
2 jeeps or cross-country vehicles
1 105-mm gun
Total 14 tons
in a single drop

Single **loads** weighing **6.5 tons** have been parachuted



S. A. des Ateliers d'Aviation **Louis BREGUET** 24, rue Georges-Bizet - Paris 16e

The tubeless tire that stands the **Cold Test**— and **Red-Hot** Landings!

The engineer pictured above is getting a reading of *minus 65° F.* on the Goodyear Tubeless Airplane Tire just taken out of the freeze room.

In a couple of seconds it will be run smack against the landing test machine to prove a point:

Goodyear Tubeless Airplane Tires can stand the test of extreme temperatures — can qualify for arctic or tropic service on the same airplane where other tires may fail!

One reason for this is that Goodyear has developed new compounds and processes which maintain a barrier against air seepage where other materials break down and disintegrate when operating in extreme cold.

Much of this topflight performance which has made Goodyear Tubeless first on so many aircraft can be laid to an exclusive Goodyear development:

3T Nylon, processed and tempered by multimillion-dollar equipment.

As a result, these tires — bonded ply upon ply with natural rubber, girded with cord that tends *to "fight back" rather than stretch* under heat — give performance that is downright revolutionary.

Their dependability for jet age aircraft can be summed up in one clear fact: *More aircraft land on Goodyear tires, wheels and brakes than on any other make.* Goodyear, Aviation Products Division, Akron 16, Ohio, and Wallasey, England.

"TEMPERATURE-TESTED TIRES" with 3T Nylon by

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AVIATION
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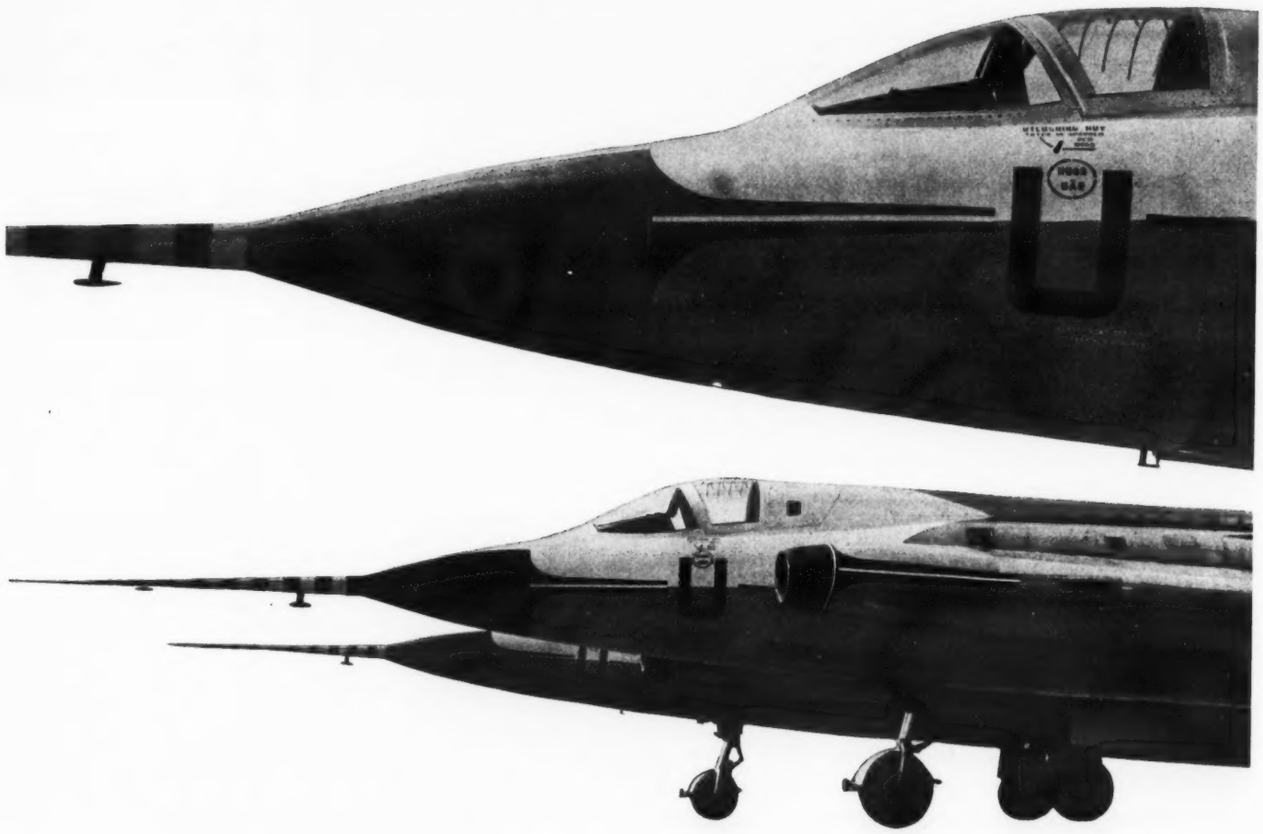

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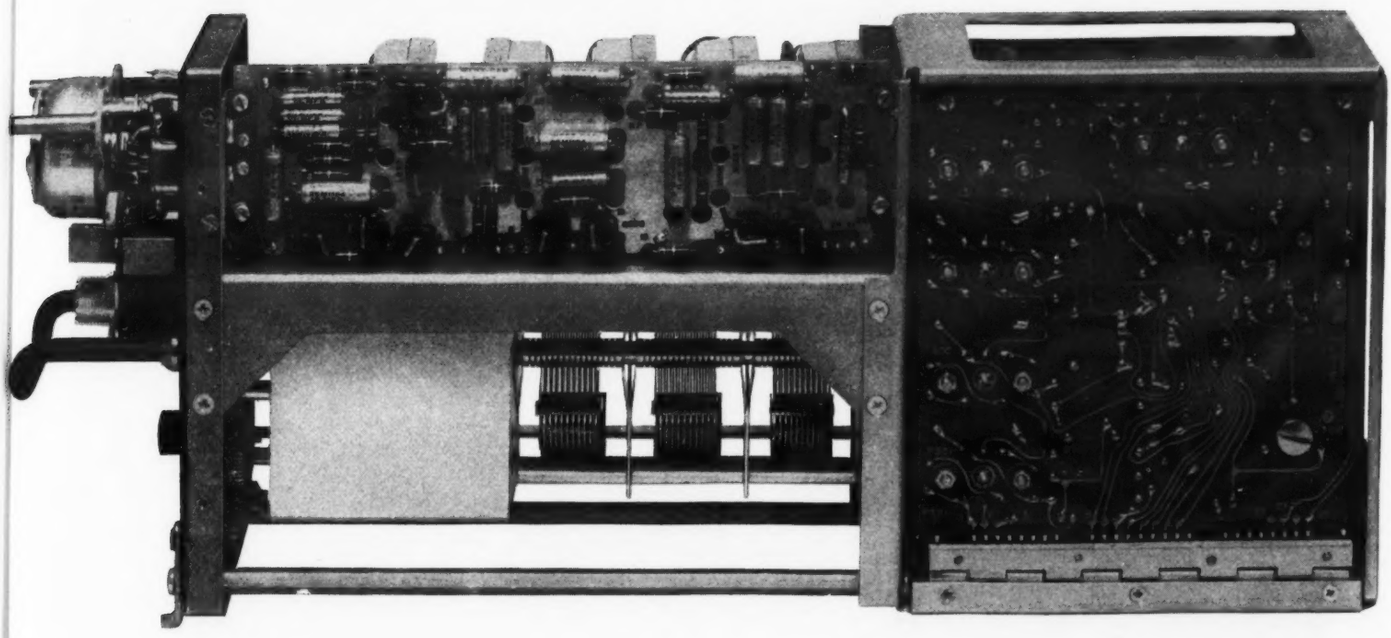

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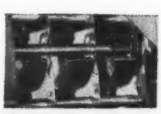

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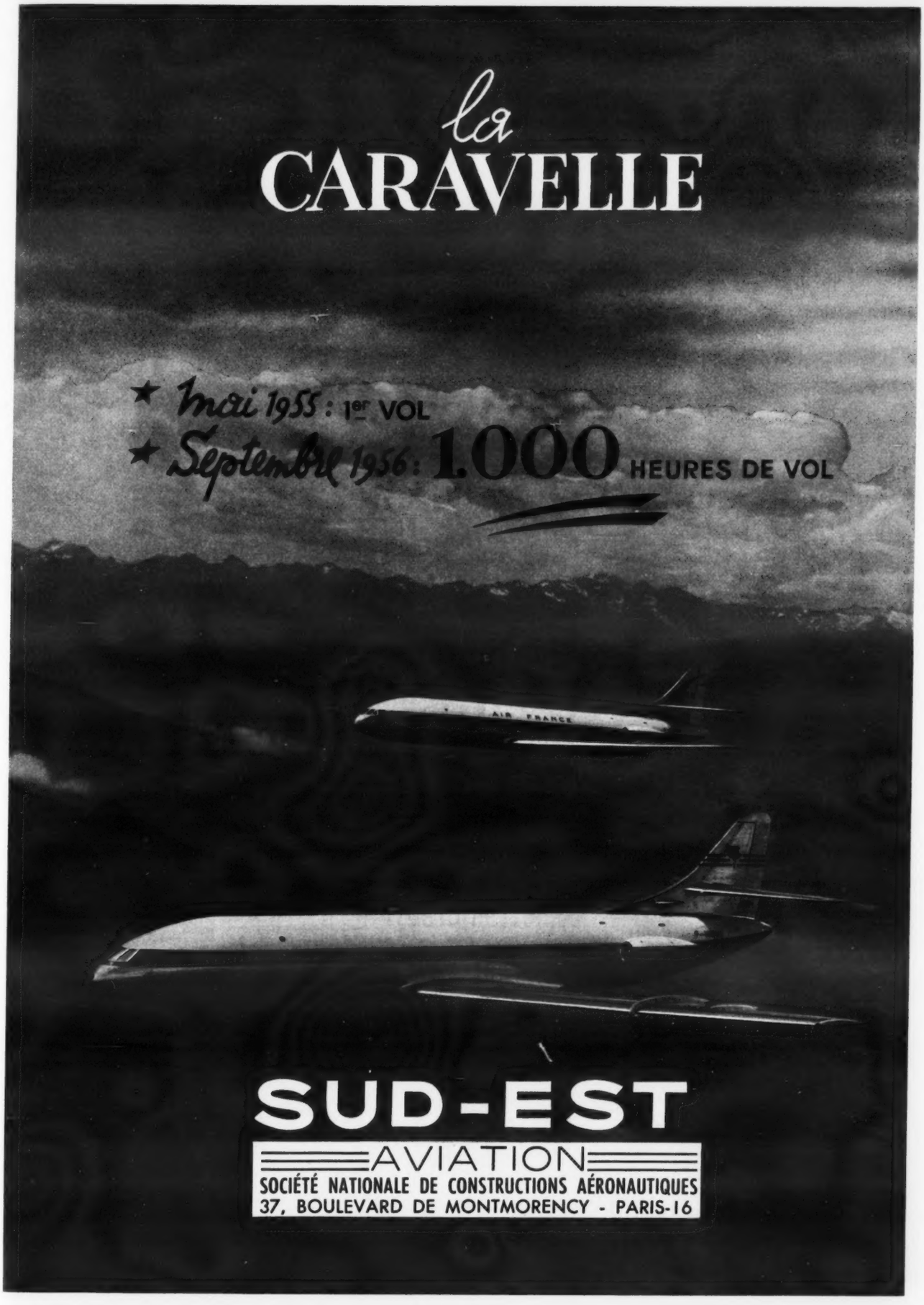
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INTERAVIA

Deadline Notes

No 2, 1957

TO SPEED UP THE U.S. MISSILE PROGRAMME the Department of Defense has been authorized to apply super priority to obtain materials and components needed for the ballistic missile. This is the first major break with policy adhered to since early in the Korean War that programmes of a defence nature should be treated equally from the standpoint of obtaining materials and components. Actually, the order providing the super priority was issued last October by President Eisenhower. However, it was then held up because of the political situation. In his budget message to Congress, the President asked for an increase of $533,000,000 in missile spending over the current year, bringing the total to more than $2,000,000,000 for the first time. - Meanwhile, the Defense Department has awarded three contracts for missile airframes totalling $570,000,000 to Convair, Glenn L. Martin and Douglas.

REORGANIZATION OF BRITAIN'S DEFENCE: Sweeping new powers for Defence Minister Duncan Sandys to enable him to reorganize Britain's armed forces were announced in the House of Commons by Prime Minister Harold Macmillan on January 24th. The Prime Minister said he had entrusted Sandys "with the task of formulating in the light of present strategic needs a defence policy which will secure a substantial reduction in expenditure and in manpower and to prepare a plan for the reshaping and reorganization of the armed forces in accordance therewith". Sandys would have authority "to give decisions on all matters of policy affecting the size, shape, organization and disposition of the armed forces, their equipment and supply, including defence research and development, and their pay and conditions of service". The first step in the reorganization was the assignment of one of Britain's top-ranking military men as Personal Chief of Staff to the Defence Minister. He is Marshal of the Royal Air Force Sir William Dickson, whose present assignment is Chairman of the Chiefs of Staff Committee. - The Prime Minister added that the first priority for defence was a long-term plan "of which the first fruits must be the defence estimates for this year". - Defence cuts announced earlier (disbanding of Royal Auxiliary Air Force and Royal Naval Volunteer Reserve squadrons and nine of thirty Auxiliary Fighter Control Units) were seen as clearing the way for an integrated defence programme with much closer ties between the three services, and possibly an eventual merger.

THE EUROPEAN CIVIL AVIATION CONFERENCE will hold its next session in Madrid on April 24th, 1957.

THE NON-STOP ROUND-THE-WORLD FLIGHT BY THREE BOEING B-52 BOMBERS, which flew from California via Newfoundland, the Atlantic, Middle East, Indian Ocean and Pacific Ocean and back to California, with several in-flight refuellings, and made a simulated atom bomb drop near Malaya, is described in Washington as a convincing proof of the value of the U.S. Air Force's global strategy and world-wide system of bases.

HOW FAR CAN U.S. MISSILES RANGE? United States and Brazilian representatives have signed an agreement for the establishment of an American guided missile tracking station on the Brazilian island of Fernando do Noronha. The island is more than 3,700 miles from the launching bases in Florida. - The Northrop SM-62 Snark missile which recently went astray over the Caribbean, landing in the Brazilian jungle instead of making a right-about turn and returning to Florida, also covered a distance of more than 3,700 miles. By comparison the distance between New York and London is roughly 3,400 miles.

THE CARAVELLE TOUR OF AMERICA: France's SE.210 Caravelle medium-range jet transport is to make an extensive demonstration tour of South, Central and North America. Points of call will include Rio de Janeiro, Buenos Aires, Caracas, Miami, Mexico City, Washington, New York, Chicago, Los Angeles, San Francisco, Seattle, Montreal etc. - The French Ministry of Posts and Telegraphs has issued a special 500 franc airmail stamp with a reproduction of the Caravelle.

PEMBROKE TWIN-ENGINE MULTI-PURPOSE AIRCRAFT to a value of £2,000,000 have been ordered from Hunting Percival Aircraft Ltd., of Luton, Bedfordshire, by the West German Government. Delivery is to be made within a few months.

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. has announced a reorganization of the design staff under which all design activities will be shared by three chief engineers, each specializing on one of the firm's main activities. The three chief engineers will be Basil Stephenson (civil aircraft), H.H. Gardner (military aircraft) and Brigadier J. Clemow (guided weapons). Overall technical direction remains in the hands of Sir George R. Edwards. In making the announcement, the company said it was felt that civil and military aircraft have, for some time, been developing on diverging lines, and this divergence is increasing.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

DOUGLAS AIRCRAFT CO.'s net income for the fiscal year ended November 30th, 1956 amounted to $33,202,-000, compared with $28,215,262 the previous year. Earnings per share rose from $7.65 to $8.96 and sales from $867,504,228 to $1,073,515,000. Order backlog at the end of December 1956 was $2,232,000,000. The Board of Directors has declared an extra dividend of 50 cents per share, in addition to the regular quarterly dividend of 50 cents.

AN ADDITIONAL $70,200,000 CONTRACT FOR F-106As and supporting equipment has been awarded to the Convair Division of General Dynamics Corp. An initial $83,000,000 contract for these aircraft was disclosed last summer.

PERMANENT RIGHTS FOR S.A.S.' POLAR ROUTE are being sought. The Ambassadors of Sweden, Norway and Denmark have asked the U.S. State Department to agree to negotiations on the subject. When the temporary agreement was concluded in November 1954, it was stipulated that before this arrangement expired in November 1957 negotiations should be started to see if a permanent agreement were justified. It was also provided that S:A.S. should submit statistics to the U.S. Civil Aeronautics Board to show whether or not a permanent route could be justified by traffic results. The Ambassadors are said to have contended that since British Overseas Airways Corporation and Deutsche Lufthansa have been granted the right to use the Polar route on a permanent basis, it seemed reasonable for S.A.S., the pioneer of the Arctic route, to obtain permanent authorization. (B.O.A.C. and Lufthansa have so far not made use of their rights on this route.) - It is also learned that the State Department has agreed to resume negotiations in March with K.L.M. Royal Dutch Airlines, which has also asked for permission to use the Polar route on a permanent basis.

STOCKHOLM'S NEW INTERNATIONAL AIRPORT should be built at Ska-Edeby, roughly 15 miles west of Stockholm, according to the recommendations of the special airport committee presided over by Ake Rust. Estimated cost of construction is 180,000,000 crowns. Although the earlier plan for an airport at Halmsjön would cost only 125,000,000 crowns, it had been dropped in favour of the Ska-Edeby site for the following reasons: Halmsjön is further away from the city (25 miles), its expansion would necessitate modifications to Bromma airport and to Barkaby military air base, and both S.A.S. and the Civil Aviation Committee would face higher operating costs. It is recommended that the Halmsjön runway should be kept as a reserve, and Bromma be used for some domestic services and charter operations.

THE WEST GERMAN LUFTHANSA carried a total of 228,680 passengers, 1,961 tonnes of freight and 1,056 tonnes of mail during 1956, its first full operating year. Average passenger load factor was 52%. Total tonne-kilometres available rose from 25,000,000 in 1955 to 70,000,000.

THE EAST GERMAN LUFTHANSA, following the example of Russia's Aeroflot, will operate agricultural, aerial survey, advertising and sight-seeing flights this year, in addition to regular and charter services.

THE CZECHOSLOVAK AIRLINE C.S.A. has, according to unconfirmed reports, ordered three Tupolev Tu-104 which it plans to put into service this summer on the routes to Moscow and Cairo. A group of 18 Czechoslovak pilots and engineers is said to be in Moscow on a Tu-104 familiarization course organized by Aeroflot. -C.S.A. will also receive five additional twin-engine Ilyushin Il-14 medium-range transports from the Soviet Union this spring. The aircraft have already been taken over by the Avia works in Prague, where their layout is being modified to accommodate 22 passengers instead of the usual 18.

*

WORKSHOP BRIEFS . . .

A group of Czechoslovak engineers is reportedly visiting Moscow to discuss technical details of a joint Russian-Czech programme for development of a turboprop aircraft. * Douglas A3D Skywarrior twin-jet Navy aircraft are being converted for use as tankers. Equipment is being supplied by Flight Refueling Inc., Baltimore, Md. * Sikorsky is developing a new turbine-powered helicopter for 17 to 20 passengers. Two General Electric T58 turbines will probably be used. * Vickers-Armstrongs has prepared a project for a pure freight version of the Vanguard. * The Breguet B.904 high-performance glider has completed its official certification tests. A batch of 15 has been ordered. * Main contractor for the new Polaris I.R.B.M. is Lockheed Aircraft Corp.'s missiles division. Polaris is being developed for the U.S. Navy. Lockheed will build the airframe, while Aerojet-General Corp. has been entrusted with development of the rocket motor (solid propellant), and General Electric Co. and the Massachusetts Institute of Technology with that of the guidance system. * Monthly output of the Dassault Super Mystère SMB.2 fighter is shortly to be increased to 15. The first SMB.2 was completed at the end of January. The following plants are engaged on production of this aircraft: Générale Aéronautique Marcel Dassault's Argenteuil plant and Sud-Est Aviation (Toulouse) are building fuselages; S.N.C.A.N. (Bourges) wings, Dassault (Talence) tail units, and Dassault (Bordeaux-Mérignac) final assembly. * It is understood that a group of six major British firms with transport interests has set up a "working party" to study a supersonic transport design in cooperation with the Royal Aircraft Establishment at Farnborough.

* * *

In the Service of Mars and Mercury

The coming air cargo fleets

"In today's world, with wars of the kind to be expected, a soldier on the spot, ready to fight, is a far mightier force than an airplane far away that might release a big bomb if it should decide to take off. At Suez with an adequate airlift for troops, the British and French would have had the Canal in the time it took them to waste their bombs from airplanes and to accomplish nothing." — Washington's "U.S. News and World Report" of December 7th, 1956, quoting top U.S. Generals.

The first practical example of this contention was provided by Göring's transport squadrons, composed of three-engined Lufthansa aircraft—though strictly speaking the Luftwaffe Commander-in-Chief had no part either in setting up or in operating these squadrons. Credit for the Luftwaffe's transport arm must go to two of the old Lufthansa's bosses, one of whom was unfortunately only too pleased to become a general, while the second took this rank very unwillingly. Incontestably, neither the German landing in Norway nor the occupation of Crete would have been possible without these transport units. And the Russian campaign would probably not have outlived the first winter; it was already decided against the Third Reich when the German transport squadrons, including Lufthansa's fleet, were wiped out in the great encirclement battles of the Eastern front, in particular Stalingrad.

The lessons of this first example in the history of modern war have been learned in some quarters but not in others. France's aircraft industry, revived to new life after World War II, was for many years hardly in a position, even from the purely financial point of view, to consider large-scale production of transport aircraft. But had the British put their money into a transport fleet of aircraft such as the twin-engine Fairchild C-123, instead of into the ambitious but costly *Brabazon* programme or the heavy four-jet bombers, the generals quoted at the head of this article would not have been able to claim that nothing had been accomplished at Suez: the Union Jack would have been flying along the whole Canal within forty-eight hours.

*

Today there are only two powers who can claim to possess a large military air transport fleet, the U.S.S.R. (within limits) and the U.S.A. The Soviet Union in certain respects has copied the old German example, since Aeroflot, the civil airline, is responsible for both commercial services and military transport duties. The United States already had a large number of transport squadrons at the end of the war, some of them attached to the Army (A.T.C. = Air Transport Command), and some to the Navy (N.A.T.S. = Naval Air Transport Service). After the war no effort was spared in welding these units into a mighty auxiliary arm; the reader will learn how M.A.T.S. (Military Air Transport Service), as since built up, has repeatedly given proof of its *raison d'être,* during the Berlin airlift, in Korea and elswhere.

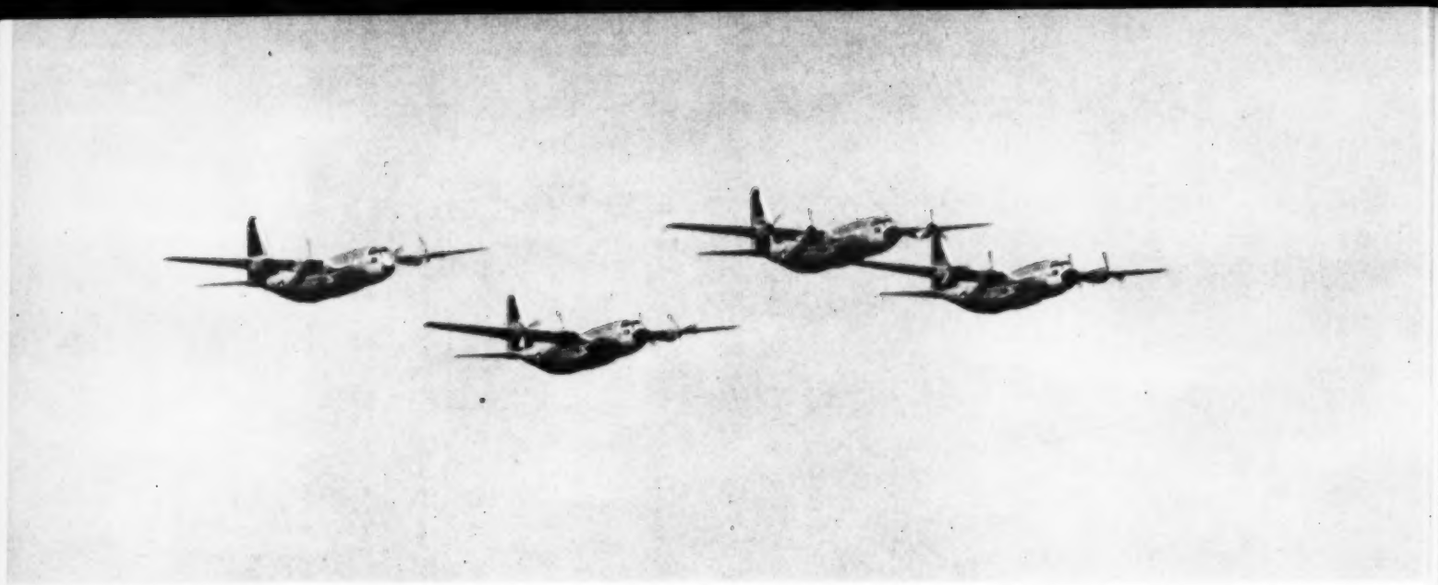
The reader will also see that the overall organization of M.A.T.S. is still in the build-up stage. The Americans must be freely complimented on the fact that, though they are at times slow in their planning, they are unwaveringly consistent in the execution of their plans. They were not content with a theoretical recognition that a large, speedy, commercial airliner is excellent for passenger services but is no more than a makeshift solution for cargo transport. As a result of this recognition the American commercial air fleet is receding more and more into the position of an additional reserve, for second-line use in an emergency, a reserve with which it may be possible to dispense in a few years' time. *Cargo aircraft need neither sound-proofing nor comfort. Cargo aircraft must be designed to be economical, to serve both war and peace, both Mars and Mercury.* In a global war it would no longer be a case of transporting a few paratroops, spares or emergency supplies to the front—*In a global war whole armies would have to move by air.*

It is with this object in view that the new giant transports, now in production on the coast of California, have been developed. *They are modern war's counterparts to Hannibal's elephants, and may well be imitated elsewhere.*

Some time ago Donald W. Douglas, whose name will always be intimately connected with air transport, calculated that operating costs for the giant C-132 should work out to 3.5 cents per ton-nautical mile. Today, operating costs in European air transport are roughly 30.5 cents, or nine times as high! Like all comparisons, however, this one, too, is inconclusive, since it is difficult to compare American and European operating figures as long as European air transport must of necessity operate less economically because of higher costs of fuel, spares, and overhead.

Nevertheless, these figures provide substantial food for thought. An entirely new precedent in U.S. air transport was set a short time ago when the U.S. Navy chartered a DC-6A cargo aircraft to a private airline. What would happen if the increasingly powerful organization that is M.A.T.S. were to decide tomorrow to hand over part of its transport fleet to the civil airlines on a charter basis? What if M.A.T.S. calculated that this would be the simplest and most economical way to maintain an extensive reserve of flight personnel, to amortize these heavy transports in peacetime and at the same time to promote national economic interests?

Then U.S. airlines could cover the whole air freight market. For example, they could operate across the North Atlantic at one third or one quarter of present rates. This would be a bitter blow for the European airlines . . . They would then be obliged to consider once again whether it might not be advisable to pool or—to use the fashionable word—integrate their overseas air freight market. This is what may yet happen! *EEH*



The U.S. Air Force can increase its transport potential three to fivefold by operating the Lockheed C-130A *Hercules* multi-purpose transport.

Military Air Transport within Atomic Strategy

by "MILES"

In shattering the traditional bases of international policies and diplomacies, the air-delivered atomic weapon brings mankind face to face with two separate dangers:

- *Global war,* the likelihood of which recedes as the major Powers increase their ability to destroy each other.
- *Localized conflicts,* which form a permanent and even a commonplace threat and will become increasingly frequent as the likelihood of recourse to global war diminishes.

It is obvious that, in the event of a fresh world war, all traditional military doctrine and weapons would fail. Moreover, in the aero-atomic age, even trials of strength in which the aggressor deliberately limits his objectives and his weapons have a chance of success only if they are carried through before the adversary has time to organize his defences. Thus in both global and localized operations, surprise and rapidity of execution are the essence of success. The events in Egypt support this contention.

In other words, in both types of armed conflict the rapid transport of men and materials becomes an imperative necessity. The belligerent wishing to take his adversary by surprise can use only those forces which are immediately available to him, since mobilization on the old style would betray his intentions.

The supply problem in atomic warfare

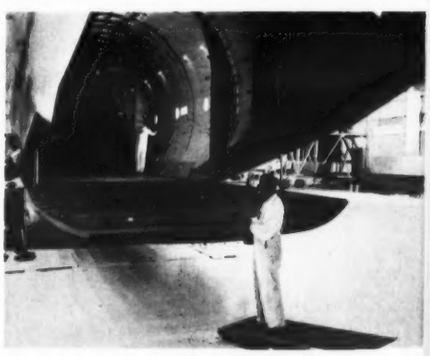
Unlike the bomber and fighter squadrons, air transport units would not be targets of the initial onslaught. Despite their overall importance, they would not have top priority in the eyes of an aggressor, whose first concern would necessarily be to destroy his victim's aero-nuclear reprisal forces. The defender has, therefore, no need to keep his transport fleet on constant alert or widely dispersed on the ground or in the air, like the strategic bomber units.

On the other hand, the defender's lines of communication on land and at sea can be cut within a few hours. Even a handful of aircraft or guided missiles would suffice to disorganize the whole surface logistics system with its extensive land and sea routes converging on land bases and ports. The extreme vulnerability of the surface communications system cancels out the traditional advantage of fighting on interior lines.

Finally the damage inflicted by both sides would be so tremendous that enormous quantities of equipment and personnel would have to be moved to the regions affected. With surface communications paralysed, this task could be performed only by vast fleets of transport aircraft. For the first phase of these

The giant Douglas C-133A strategic transport, developed for the Military Air Transport Service, will achieve three times the daily transport performance of the Douglas C-124 *Globemaster II* now in service.

The Douglas C-133A loading ramp for more than 50 tons payload.



operations at any rate the transport potential required could not be provided by mobilizing civilian fleets, since time would be too short.

For these reasons the rapid movement of men and supplies should be organized as outlined below.

The Boeing KC-135 jet tanker/transport, which is to go into service with Strategic Air Command this Spring, refuelling a Boeing B-52 *Stratofortress* eight-jet bomber over the Pacific.

What is required of the transport fleet

Since the military phase of operations would be very brief, the transport units would have to intervene immediately and in force. An achievement such as that of the U.S. Air Transport Command during World War II, when nearly 1,250,000,000 ton-miles were produced between 1942 and 1945, would no longer be good enough. In commercial air transportation aircraft are evaluated according to the number of ton-miles they can perform during an operating year. During World War II calculations were based on output per month. Tomorrow the unit of time will be a day or even, perhaps, an hour. This explains the programmes for heavy military transports on which the major American aircraft manufacturers are now working. An aircraft such as the Douglas C-124 can produce some 125,000 ton-miles in 24 hours (after deducting loading and unloading periods and technical calls). But the new Douglas C-133A, used under the same conditions, would have three times this transport capacity. By replacing the Fairchild C-119 *Flying Boxcars* with Lockheed C-130 *Hercules* the U.S. Air Force can multiply its transport potential four or even fivefold.

At the end of World War II Reginald M. Cleveland, author of an excellent book on American air transport[1], estimated that approximately 10,000 aircraft were used to supply the Allied land, sea and air forces on all war fronts. Assuming that some 2,000 of these were four-engined types in the C-54 category and that each aircraft had a daily average utilization of ten hours, total average output could well have been 620,000 ton-miles per day. The same calculation applied to the Douglas C-133A's design performance reveals that, during the few days when such aircraft would be vital, the U.S.A.F.'s future four-engined turbine-powered transport could produce more than 300,000 ton-miles per day per aircraft. Thus a fleet of 200 Douglas C-133A's would be capable of moving the same quantity of men and materials as the whole 10,000 C-54s, C-47s, C-53s, C-46s, etc. in World War II.

Some two years ago Hanson W. Baldwin published in the "New York Times" a map showing the roughly 150 air bases outside Federal territory that would be available to the United States in case of need. The logistic support of these bases, most of which are thousands of miles from the American supply centres, necessitates an impressive transport fleet ready at all times for instantaneous action. Even if this fleet consisted of a thousand aircraft, each of which could move an average of 10 tons at 250 m.p.h. (which is not yet the case), it could not produce more than some 45,000,000 ton-miles during the first 24 hours. A theoretical calculation shows that, assuming the average distance to be covered to be 3,000 miles, a fleet of 1,000 aicraft could deliver roughly 75 tons to each of the 150 bases. However, in view of the time required for the return flight and for technical maintenance, this performance could not be repeated every day, but at best twice or three times a week. Admittedly the calculation is purely theoretical. Some of the bases would probably be destroyed, which would reduce the amount of air work required, at any rate during the first few hours. But if, as General Le May has stated, the advance bases available to S.A.C. are indispensable to the bombers' efficiency (for technical landings, flight refuelling), they would have to be kept supplied. The volume in which transport aircraft of the 130 series (Lockheed C-130, Douglas C-133 and C-132, Boeing KC-135) could be produced is not publicly known, but it is obvious that only heavy turbine-powered equipment could solve the problem of providing immediate supplies for world-wide bases.

[1] "Air Transport at War".

Fairchild C-119 *Flying Boxcar* assault transport, workhorse of the U.S. services, can carry a whole motorized machine gun platoon, consisting of a jeep with two trailers, four 5-inch machine guns on mounts, ammunition and spares, and seven men.

The YC-123 prototype of the Stroukoff C-134 freighter, with "Pantobase" combination undercarriage and flotation unit.

Airlift

Speed a cardinal virtue

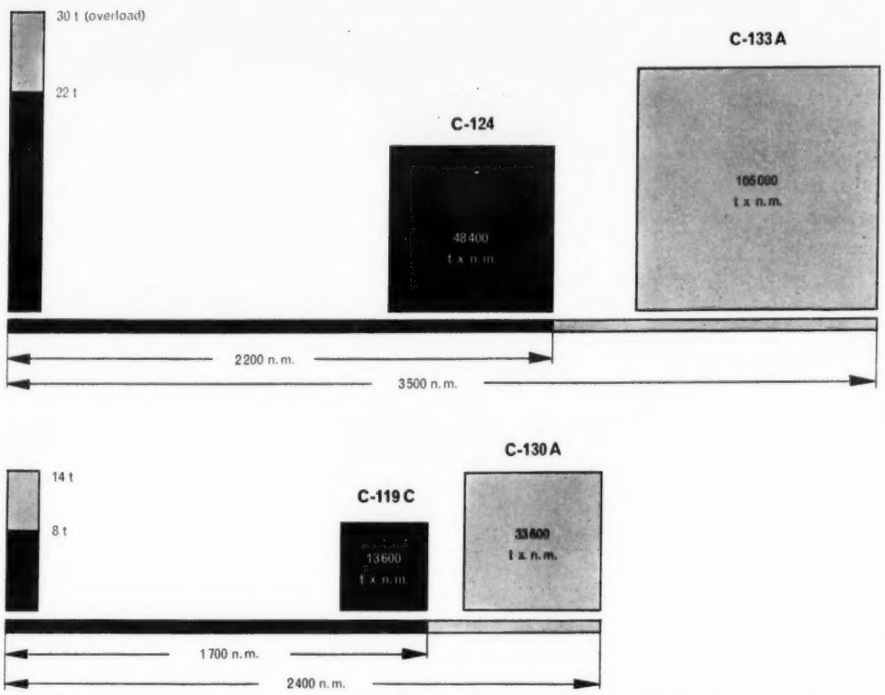
As already seen, the transport potential immediately available is one of the basic essentials for a global supply system. A second requirement, no less vital, is speed. General E. W. Rawlings, of the U.S. Air Force's Air Materiel Command, writes in the "Air University Quarterly Review": "In the American Revolution, the average speed of supply to American troops had been about 1⅓ miles per hour. As World War II ended, an average of 106 days was required for delivery of an item requisitioned by forces in Germany. The average speed of supply was about 3½ miles per hour." In any future aero-nuclear war events would move so rapidly that yesterday's 106 days would have to be reduced to less than 106 hours. This would eliminate surface transport, at any rate during the atomic phase of the conflict.

The U.S.A.F. has attempted to meet the speed problem in two ways: by increasing the actual speed of its transports and by rationalizing the supply system.

In presenting the C-133A to its future users, "M.A.T.S. Flyer" stated that in long-range operations cruising speed would be higher than the maximum speed of most of the World War II piston-engine fighters. And Douglas indicates that the XC-132 project (four T-57 turboprops of 15,000 h.p. each) will have a speed of Mach 0.9, like the fastest fighters of less than ten years ago.

Secondly, the Pentagon attaches great importance to the *rationalization of the logistics organization*. According to General Rawlings, about 80% of the time elapsing between requisition and receipt of a given item by a combat unit is taken up with administrative formalities. The actual transport operation takes at most 20% of the total time, so that the effect of higher aircraft speeds is limited. Thus the main problem is to reorganize the administrative side of the work. The new American logistics system is reportedly based on automation, with electronic computers to keep up to date the gigantic inventory, with its million or more different items, to calculate replacement needs and thus cut down the quantity of costly supplies held at advanced bases, where they are particularly vulnerable to attack. Even when surface transport is used, the advantages of automation are substantial.

For example, by reducing the supply cycles for engines from four and a half months to three, it has been found that the number of engines needed for a given operation can be cut by 33%.

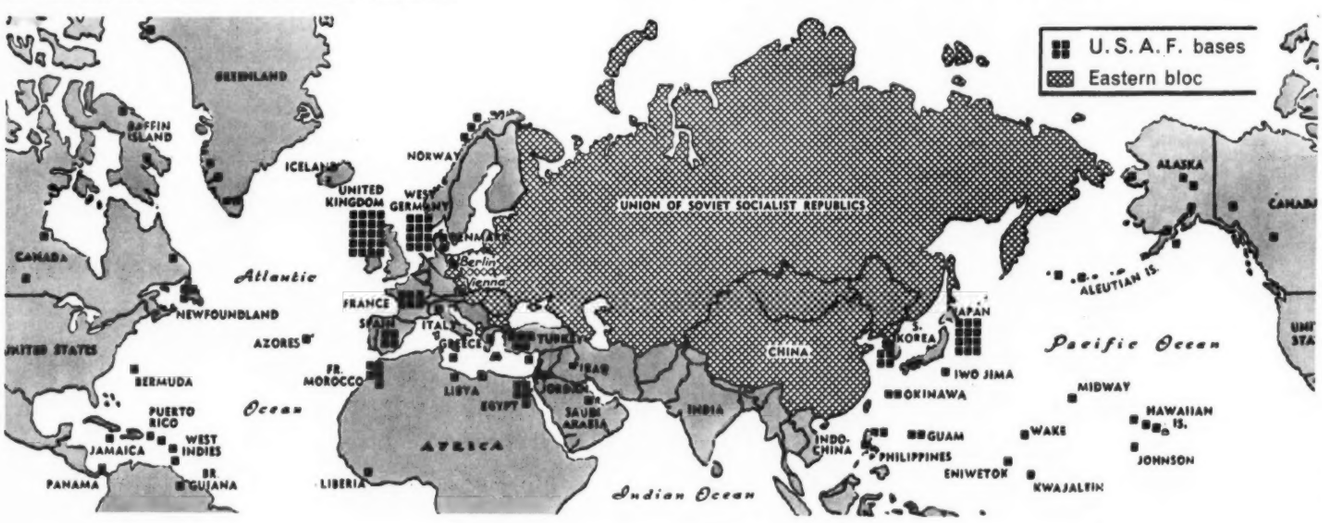


Comparison between the maximum stage transport capacity of the Douglas C-124 and Douglas C-133A strategic transports (with overload; top) and the Fairchild C-119C and Lockheed C-130A tactical transports (with overload).

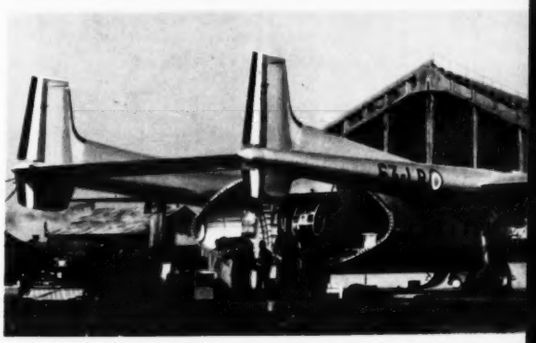
C-124: 22 tons × 2,200 nm = 48,400 ton-nm **C-119C: 8 tons × 1,700 nm = 13,600 ton-nm**
C-133A: 30 tons × 3,500 nm = 105,000 ton-nm **C-130A: 14 tons × 2,400 nm = 33,600 ton-nm**

The above listing takes no account of the transports' very varied cruising speeds, so that the daily transport capacity of modern types, compared with older models, is more favourable than appears from the diagram.

Some two years ago "The New York Times" published this map prepared by its military correspondent Hanson W. Baldwin, showing the roughly 150 air bases available to the U.S. Air Force outside the United States in the event of war.



A 90-mm anti-aircraft gun on the loading ramp of a C-124 at McChord AFB, Washington.



The freight hold of a Nord 2501 *Noratlas*.

The commercial fleet is only an auxiliary

In the foregoing the need for a military transport fleet that is instantly available has been stressed. Does this mean that the civil fleet would be of only meagre assistance? This question is answered by the report of a group of American experts, who recently estimated that, solely to meet requirements within the Continental United States, the commercial fleet would have to produce at least 5,500,000,000 ton-miles a year, or twice as much as in peacetime.

The Civil Reserve Air Fleet already in being includes 317 four-engine aircraft. But in a global aero-nuclear war this fleet would have two weaknesses: it would not be immediately available and it would not initially be equipped to meet military transport requirements. When questioned on this point, Roger Lewis, at the time Assistant Secretary of the Air Force (Materiel), replied: "In transocean traffic we know that cargo cannot be economically and efficiently carried in passenger-type aircraft ... We know also cargo aircraft are not efficient for transporting people. In other words logistics aircraft cannot be compromised by multiple-purpose design criteria ..."[2]

Moreover a committee of experts has warned the Civil Aeronautics Board that if the 317 four-engine transports attached to the Civil Reserve Air Fleet were withdrawn from the airlines and if the remaining commercial transports were used for an average of ten hours per day with a load factor of 70%, there would be a shortage amounting to 20 aircraft of the DC-7 class and 38 cargo aircraft of the DC-6A class, or a total of 58 aircraft. This very modest estimate takes no account of the greatly increased need for civil transports that would arise if the United States were attacked.

In brief, the Civil Reserve Air Fleet would be widely used—though for the transport of troops rather than cargo—but in the event of a surprise aero-nuclear war it would be the immediately available fleet of military transports that would count. Hence the scale of the U.S. programme for heavy four-turbine aircraft. Speaking on his projects for an ideal "logistics aircraft", Donald W. Douglas implied that an aircraft such as the C-132 could carry civil cargo at a rate of 3.5 cents per ton-nautical mile. A fleet of nine of these very heavy transports could perform as much work as 171 C-54s or 58 C-124As, at a cost of between one third and one quarter.

Here Douglas strikes at the heart of the matter. The problem of using these very heavy aircraft is no longer a technical, but an economic one. In peacetime the U.S.A.F. would not need these aircraft, but could charter them to civil cargo operators, on condition they were returned immediately when needed. A first timid beginning has been made by the U.S. Navy, which has chartered one DC-6A to Slick Airways. Immediately afterwards twelve other civil operators applied for similar charters. But would such a plan be feasible with the giant cargo aircraft proposed by Douglas? Yes, if the world freight market were within reach of American operators. A single C-133A with its payload of 45 tons could produce some 43,000,000 ton-miles a year, and a fleet of around fifty would suffice to handle all the predictable freight and thus completely overturn the world market.

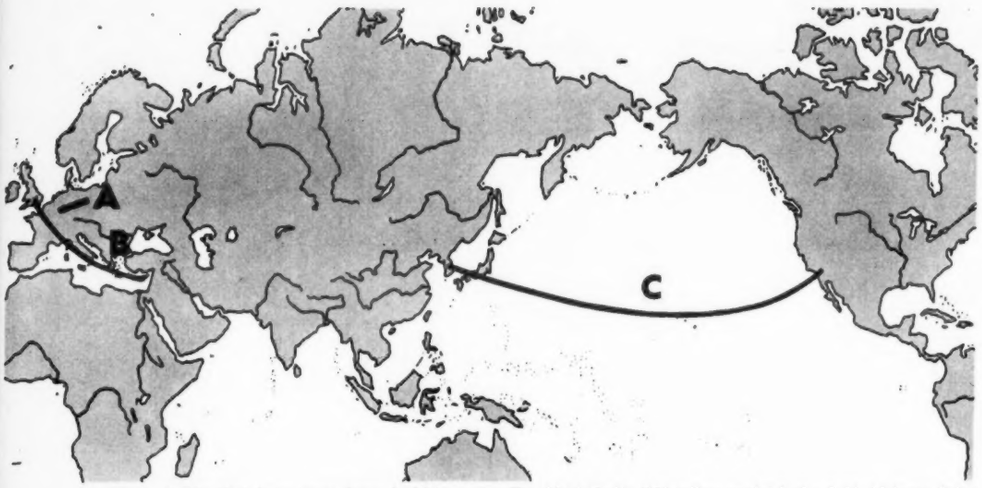
Assault transport in atomic war

Last September 21st General Maxwell Taylor, Chief of Staff, U.S. Army, attended a demonstration of an experimental Army unit which is designed as a prototype for a highly mobile army with exceptional fire power. Speaking

[2] Air University Quarterly Review, Spring 1955.

With the Nord 2501 *Noratlas* the French Air Force has laid the bases for a tactical transport fleet.

The good old Handley Page *Hastings* still undauntedly serves the R.A.F. as transport aircraft.



Three airlifts that have gone down in history: A – *Frankfurt-Berlin* (250 miles; payload of a C-54, 10 tons; flying time 1 hr 45 mins); B. *Los Angeles-Korea* (distance 6,200 miles; payload of a C-54, 5 tons; flying time 40 hrs); C. – *London-Cyprus* (distance 2,300 miles, payload of a C-54, 5 tons; flying time 13 hrs.).

at the same ceremony, Secretary of the Army Wilber M. Brucker announced that 600 aircraft were available to transport the 101st Airborne Division. The aircraft involved are doubtless types such as the C-119 and C-123 for transport operations over short distances and the C-124 for strategic movements.

The 101st Airborne Division comprises less than 12,000 men, of whom nearly 9,000 are combat troops. It is equipped with eight 20-ton launching ramps for *Honest Johns* and a substantial number of these surface-to-surface missiles (which may carry atomic warheads), as well as 90-mm guns and its own helicopter unit. It has, however, dispensed with anti-aircraft defences and reduced its wheeled transport to a minimum. On the other hand, since it must be able to build airstrips rapidly in order to receive supplies, it has special, relatively light-weight bulldozers. All this equipment, with the exception of the helicopters, is or will be parachutable. Assuming that the total weight of the armed troops plus supplies for three days of fighting will be 2,000 tons and that the heavy equipment—excluding the *Honest Johns*—will weigh another 2,000 tons, the total to be transported at one time will be 4,000 tons. It is thus readily understandable that 600 present-day medium transport aircraft should be required, and equally clear that no Power can afford the 6,000 aircraft needed to move ten units such as the 101st Airborne Division.

The European countries are also studying the same problems on a more modest scale. Since the advanced bases would probably be destroyed and the surface supply system disrupted, Europe's land and air forces would have to rely on such supplies as could be brought in by short-range transport aircraft, more or less under enemy fire. As long-distance transports would not be needed within a European theatre of war, Europe can concentrate on relatively light aircraft with a high load capacity but limited range, capable above all of operating without concrete runways, from simple grass fields.

If the quantity of supplies required per man and per day is taken to be 65 lbs., the figure generally accepted in non-atomic warfare, the total weight needed for a whole division would be some 500 tons every 24 hours. To move this load would necessitate some thirty high-capacity cargo aircraft, each making two trips a day. In an atomic war these numbers would no longer suffice, in view of the special conditions prevailing and the vulnerability of the equipment. Here too, the air transport fleet must be instantly available in order to be efficient.

Transport and localized wars

With its speed of 10 knots, the landing craft is no longer equal to the demands of the atomic age. While the Anglo-French invasion fleet was laboriously taking three days to sail from Malta to the Nile delta, Moscow, Cairo and Damascus were consulting at lightning speed. If the troops had been airborne from the start, the operation would have been a military success. But neither France nor Britain—nor the two together—possessed the necessary air

Present transport potential of the American, British and Western European civil fleets

United States civil fleet (end of 1955)
The following aircraft were in service on domestic and international routes: 141 Douglas DC-7s, 380 DC-6s, 248 Lockheed *Constellations* and *Super Constellations*, 46 Boeing 377s, 180 Douglas DC-4s, 327 twin-engine Convairs, 8 Vickers *Viscounts*, 119 Martin 2-O-2s and 4-O-4s, 69 C-46s and 368 DC-3s. Taking average figures for payload and cruising speed, this fleet could theoretically produce approximately:
3,100,000 ton-miles per hour.

Canada's civil fleet
At the end of April 1956 Trans-Canada Airlines' fleet consisted of 75 aircraft: 9 *Super Constellations*, 22 Canadair Fours, 18 *Viscounts* and 26 DC-3s. In theory this fleet could produce approximately:
99,000 ton-miles per hour.

Britain's civil fleet
In mid-1956 B.E.A.'s and B.O.A.C.'s fleets comprised approximately 21 Canadair Fours, 16 *Constellations*, 16 Boeing 377s, 28 *Viscounts*, 19 *Ambassadors*, 46 DC-3s. The corresponding hourly amount of air work was:
186,000 ton-miles.

To this figure must be added the potential of the "independents", with their 2 DC-4s, 6 *Tudors*, 21 *Yorks*, 17 *Hermes*, 32 *Vikings*, 24 DC-3s and 15 Bristol 170s, or another
80,000 ton-miles.

Western Europe's civil fleet
Total fleet of Western Europe's airlines in 1956 comprised 161 Lockheed *Constellations* and *Super Constellations*, 38 DC-6s, 52 DC-4s and *Scandias*, 12 Breguet *Deux-Ponts*, 7 *Armagnacs* and 12 *Viscounts*. The transport capacity of this fleet can be estimated at
754,000 ton-miles.

Total (North America and Western Europe)
4,219,000 ton-miles.

The 1960/62 civil and military transport potential

To date firm orders and options for Boeing 707 and Douglas DC-8 four-jet commercial transports cover a total of more than 250 aircraft. These aircraft will be distributed as follows, from the strategic point of view:

North America:	178 four-jets (including Panagra)
Europe:	60 four-jets (including S.A.S., in which Sweden, a neutral country, participates, and Swissair)
Australia:	14 four-jets (including the 7 Boeing 707s of Qantas Empire Airways).

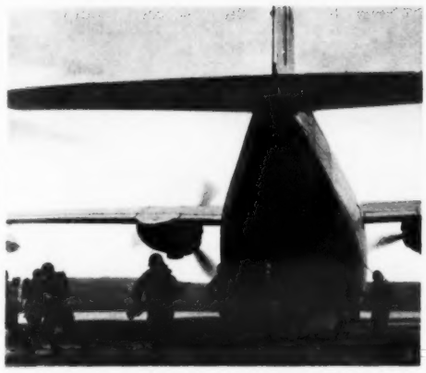
Assuming:
— 80 % readiness in North America (thanks to proximity to maintenance base) and 70 % elsewhere in the world;
— an average payload of 15 tons carried over a distance of 3,000 miles;
— a cruising speed of 530 m.p.h.;
— a daily utilization of 12 flying hours,
transport capacity per 24 hours will be as follows:

	North America	*Europe*	*Asia*
ton-miles:	13,480,000	3,700,000	930,000
	17,180,000		

In terms of combat troops (equipped with light arms) this transport potential means that the combined North American and European fleet could carry roughly 27,000 men across the Atlantic within 24 to 36 hours, or three light divisions.

If a fleet of 100 to 150 heavy cargo aircraft, of the category of those under test in the United States, were added to the civil fleets, the inter-Allied command could transport the equivalent of three fully-equipped light divisions or their atomic equipment over a distance of 3,000 to 3,500 miles. The only stocks it would be necessary to keep on the spot would be vehicles (tanks, heavy trucks), fuel and conventional weapons.

This future capacity, which will be available in four or five years from now, could modify world strategy and policies.



Sixty U.S. Army airborne troops disembarking, ready for combat, from the belly of a Fairchild C-123 *Provider*.

The Fairchild C-123 assault transport for U.S. airborne troops lands on a pasture.

transport potential. To move 10,000 fully equipped men in two waves, over a distance of well over a thousand miles, constitutes an airborne operation of considerable scale. It would have necessitated the provision of 150 aircraft, each capable of carrying 5 to 6 tons of payload over a distance of at least 1,500 miles (assuming a technical landing on Cyprus to have been feasible). Even then, the first wave would have been left without support for several hours.

Neither France nor—still less—Britain has a military transport fleet capable of successfully handling an airborne operation over a long distance. True, the French Air Force has an excellent transport aircraft in the Nord 2501 series, but financial difficulties have limited its numbers. Total capacity of the transport fleet is a military secret, but can be estimated to be around 300 to 400 tons immediately available. This could be supplemented by calling on the French civil air fleet, whose present capacity is just under 1,000 tons and could thus theoretically produce roughly 185,000 ton-miles per hour. If only 20% of this fleet were temporarily requisitioned, it would provide an additional capacity of 370,000 ton-miles per 24 hours.

For her part, Britain makes extensive use of the private airlines' fleet for trooping purposes even in peacetime. This reserve fleet of roughly fifty four-engine and 75 twin-engine transports represents an immediately available capacity of 350 to 400 tons, or, in theory, roughly 75,000 to 80,000 ton-miles per hour. Like the French private operators, the British "independents" also contributed to the Egyptian operation, alongside R.A.F. Transport Command, whose transport capacity, with its elderly *Hastings* and *Valettas*, is probably not much higher. Finally, the British could have called upon part of the B.E.A. and B.O.A.C. fleets, but competition in international air transport is so keen that the Corporations could not afford such a drain, in the case of a relatively minor crisis. Thus the two countries had to rely primarily on their military transport fleets, which were not big enough to meet the needs of an expeditionary force.

Incidentally, there has always been a critical shortage of air transport capacity whenever there has been a sudden need for it. When the North Korean army crossed the 38th parallel on June 25th, 1950, the only air transport available to the U.S. Army in the Far East was three squadrons of C-54s, two of them based on Japan and the third at Clark Field, in the Philippines. Quite apart from the early military needs, which could not be met, considerable difficulties were experienced in evacuating civilians. A few months later an airlift had been created between the United States and Japan. Though it used the same aircraft as had broken the Berlin blockade, it was far from being so effective. Whereas the C-54s carried 10 tons of payload between Frankfurt and Berlin (265 miles), they could take only 5 tons on the transocean runs (5,000 miles on the northern route, 8,000 miles on the southern route via the central Pacific). Their fuel consumption of 24 tons was nearly five times their payload. The result was that they delivered a total of 100 to 150 tons per day, compared with the 5,000 to 10,000 tons of varied cargo carried to Berlin.

On its return flight from the combat zone the Fairchild C-123 can carry 50 wounded on stretchers plus attendants.

Despite the differences between the two long-range operations, Korea and Egypt, they had one point in common: had a substantial air transport fleet been available, it might in both cases have changed the course of events.

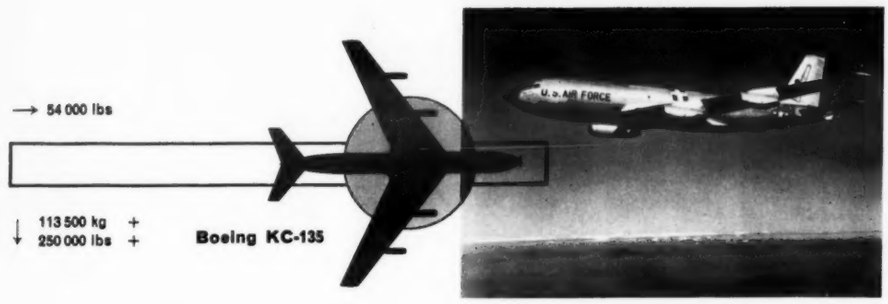
*

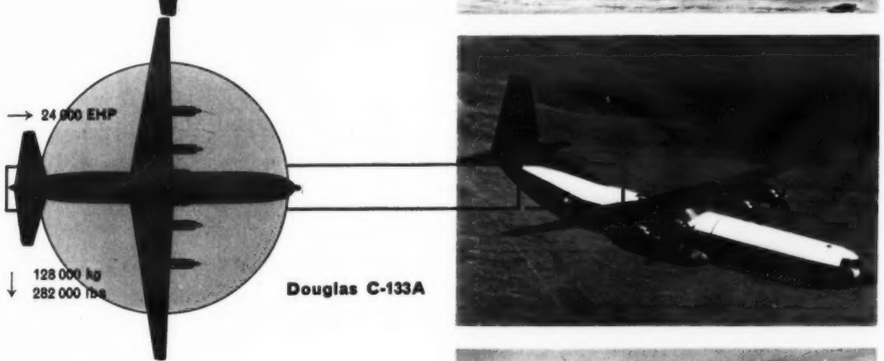
Whether in a localized conflict or in a general war, the immediately available air transport capacity may well be the decisive factor. In both cases the assistance provided by the civil fleet may be too late, too limited in scope and unsuitable for military needs.

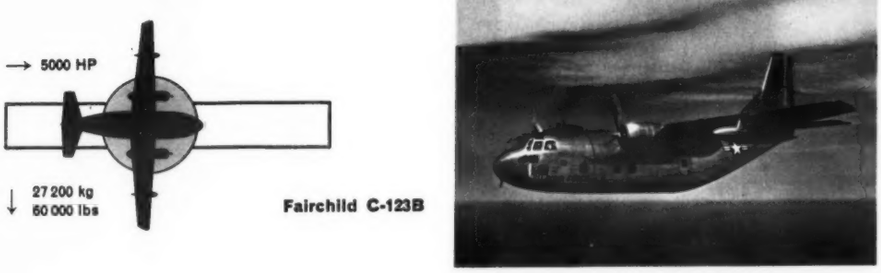
All the air Powers are aware of the advantages to be gained by speeding up air movements. Douglas, Lockheed, Boeing, Convair are all working on ambitious programmes. Britain plans to re-equip her Transport Command with *Britannias* and *Beverleys*. France is supplementing her Nord 2501s with Breguet *Deux-Ponts*, and the U.S.S.R. showed new troop transports at Tushino. But as in the field of combat equipment, so in that of military transport aircraft, a new problem is arising. The qualities demanded of these aircraft require close specialization, and it begins to look as if military transports can no longer be derived from commercial types. Though no technical difficulties are involved in designing special aircraft for this purpose, the cost will be high. Once again, as in so many other fields, only the really big Powers will be able to afford an efficient organization.

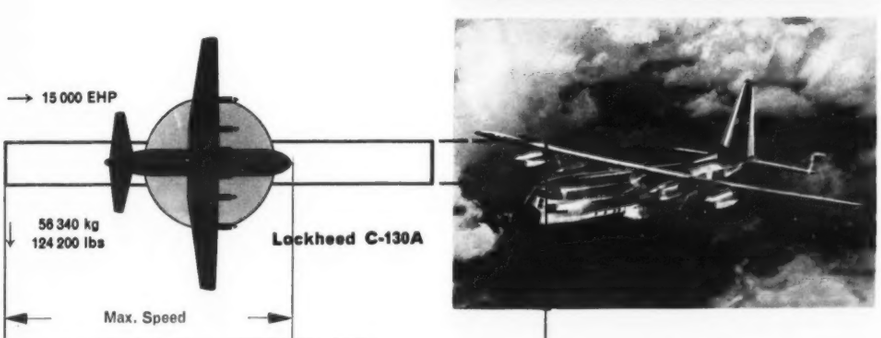
The West's Military Transports

Future U.S. Transports









INTER AVIA

● American transports

The United States' military transport aircraft take first place in the present review for several reasons: only the United States possesses a complete line of specialized air transport equipment for all range categories as instruments of its global policy; it already has an impressive number of transports (around 1,600 four-engine and several thousand twin-engine aircraft); it is in the process of increasing their number and producing new types, and it is leading the way in introducing new concepts.

It is a well-known fact that a good commercial aircraft has never been made into a good military transport, or vice versa. The best that can be hoped for is a stop-gap. Though the United States managed to meet its military air transport needs throughout World War II and during the early post-war years—up to the Berlin blockade—almost exclusively with C-47s (Douglas DC-3s) and C-54s (Douglas DC-4s) and still has a large number of these aircraft in service as "maids of all work" with the tactical units, it has nevertheless not been afraid to learn from its past difficulties and radically to renew its strategic and tactical transport fleet.

The various categories of transport aircraft, as they exist today, are described below.

I. Strategic transports and tanker/transports for the movement of Air Force units on a world-wide scale and the carriage of troops and supplies for other services over very long distances. (Tanker/transports can be used without modification either for the in-flight refuelling of combat aircraft or for ordinary transport purposes.) *Examples:* Douglas C-124 and C-133 heavy transports, Boeing KC-97 and KC-135 tanker-transports.

II. Tactical transports (assault transports) for combat cargo, parachute operations and/or airborne operations in cases where enemy counter-measures are to be expected (e. g. Fairchild C-123 and Lockheed C-130).

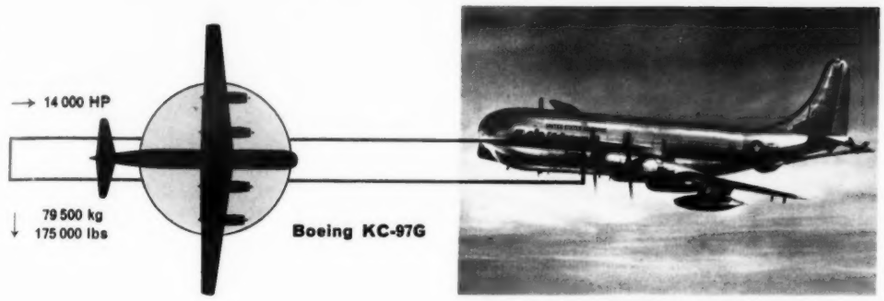
III. Pure personnel transports and evacuation aircraft for operations outside the combat zone (e. g. Douglas C-118 and Lockheed C-121).

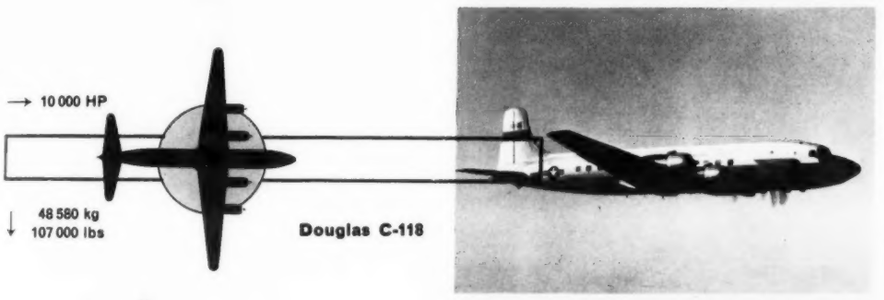
IV. Small transports (e. g. D.H.C. *Otter* and *Beaver*).

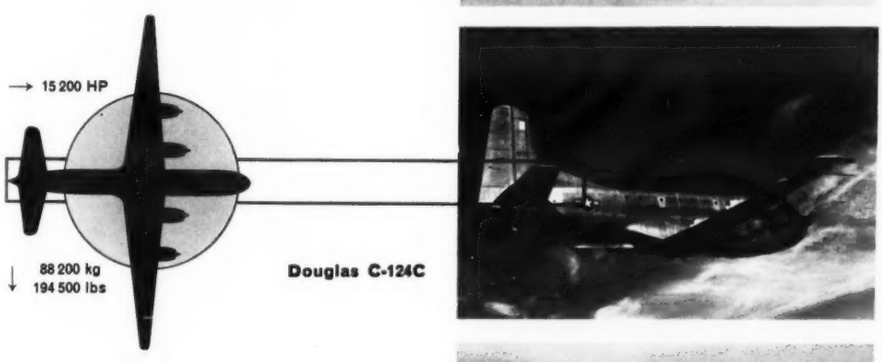
In the accompanying presentation the newer American and European transport models, some of which are in service only in small numbers, are shown on the left-hand pages, and the older types, generally in large-scale service, on the right-hand pages. The black silhouettes give an indication of the size and configuration of the aircraft; their distance from the base line (left) shows their maximum speed; engine thrust (in h.p. or pounds of thrust) and maximum gross weight are indicated in figures. Maximum payload (for greatly reduced range) is shown by a circle, maximum range (with greatly reduced payload) by a rectangle. In some cases, finally, optimum range (for typical design payloads) is also given.

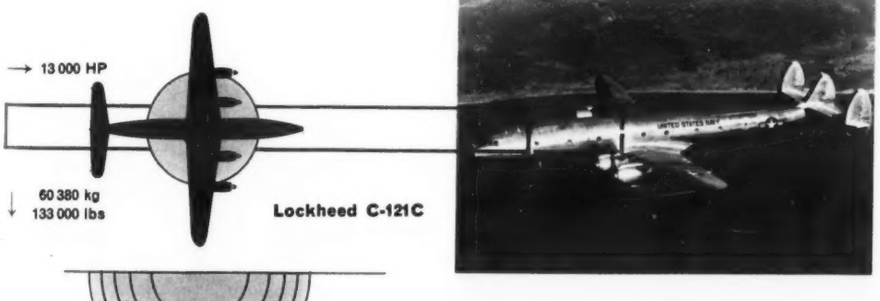
In the first place mention must be made of the *Boeing KC-135* tanker/transport (with four P & W J-57s), which, though destined primarily for the U.S. Air Force's Strategic Air Command, will also serve with the Military Air Transport Service. It is equipped with a "flying boom" underneath the rear fuselage (for a flow of 790 U. S. gals. per minute), remote-controlled from a belly blister. As the whole fuel supply for the aircraft's own use and for tanking other aircraft is carried in the wing and in the lower portion of the fuselage, the upper fuselage half is free at all

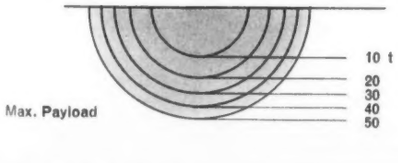
U.S. transports in service











times to take supplies, troops or stretchers. A first KC-135 has been completed, and well over a hundred more are in production for the U. S. Air Force.

The *Convair R3Y-2 Tradewind flying-boat*, which has been ordered by the U. S. Navy and is more or less the counterpart to the KC-135, is powered by four Allison T-40 turboprops. It can refuel up to four Navy fighters simultaneously, carries enough fuel for eight of these fighters; it can take up fresh supplies for refuelling purposes from submarine tankers at sea, and finally it serves as assault transport for the Marine Corps. In the last-mentioned case the flying boat manoeuvres itself on the water as close to the shore as possible, then opens its nose to allow guns, ammunition, vehicles and equipment to be unloaded via the built-in ramp. For semi-permanent emergency bases there are even dismountable docks (transportable by air), so that loading, unloading and maintenance can be greatly simplified.

The biggest transport aircraft at present in production, however, is a landplane powered by four P & W T-34 turboprops (6,000 h.p. each), the Douglas C-133A strategic transport. This colossus spans nearly 180 ft., has a gross weight of 282,000 lbs. and can carry a payload of more than 110,000 lbs. over very long stages: max. speed 320 knots; max. range 4,000 nautical miles. Yet even this heavyweight is already overshadowed by the even bigger C-132 which Douglas is building. This will be fitted with four superpowerful P & W T-57 turboprops (15,000—plus h.p. each) and will have an (estimated) maximum gross weight of around 200 long tons: payload up to 200,000 lbs.; max. speed reportedly 430 knots.

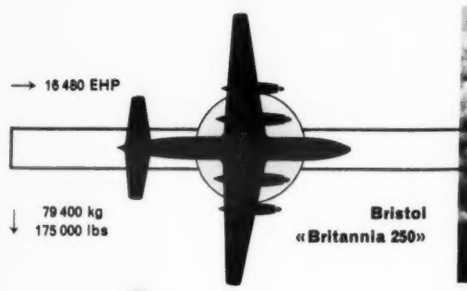
The types mentioned above all fall into the category of strategic transports, whereas the twin-engine *Fairchild C-123B Provider* and four-engine *Lockheed C-130A Hercules* are definite tactical transports. The essential structural difference between the two categories arises from the requirement that aircraft likely to be exposed to enemy fire should not carry fuel in their wings. Thus each of the Fairchild C-123B's four fuel tanks (two main tanks in the engine nacelles, two auxiliary tanks under the outer wings) can be jettisoned immediately by a simple push-button action, while operating instructions for the Lockheed C-130A insist that the aircraft should enter the combat zone only with "dry" wing, i. e., having previously used up its wing fuel, pumped it into the external tanks or jettisoned it. From the operational point of view, tactical transports also differ from strategic in that they can land and take off on unprepared grass fields in the combat zone, in case of need with reduced payload.

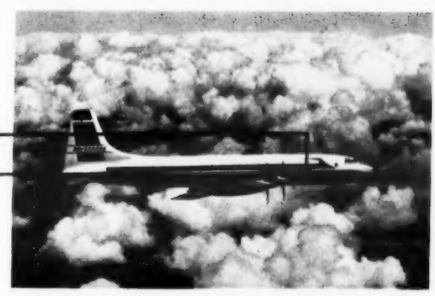
Nevertheless the Fairchild C-123B *Provider* (two P. & W. R-2800 engines) can carry up to 60 fully-equipped airborne troops into the combat zone and, on the return trip, evacuate 50 wounded (on stretchers) plus 10 attendants. Alternative loads are four jeeps or field guns and building equipment up to a total weight of 16,000 lbs. This figure applies to combat operations; for take-off and landing on concrete runways a payload of 19,000 lbs. is permissible. A certain number of C-123s are also fitted with Fairchild J-44 auxiliary jets at the wing tips, for overload operations from very rough ground. This aircraft is already in squadron service in substantial numbers; production continues.

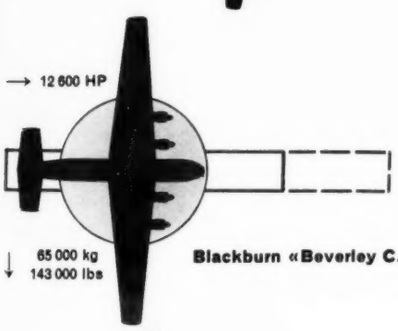
Mention should also be made of the sister aircraft, the *Stroukoff C-134*, whose prototype (YC-123) is now being tested. This amphibian transport with combination undercarriage and flotation unit ("Pantobase") will be capable of operating from all water and ice surfaces, as well as on the smallest land bases.

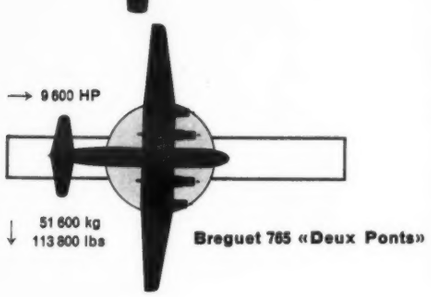
The first five Lockheed C-130A *Hercules* tactical transports (four Allison T-56 turboprops) were de-

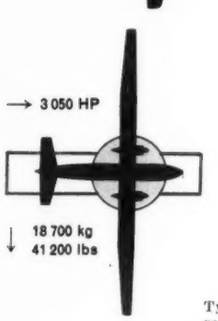
Future European transports

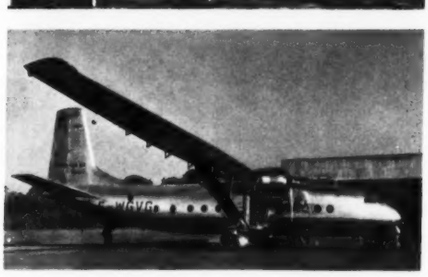




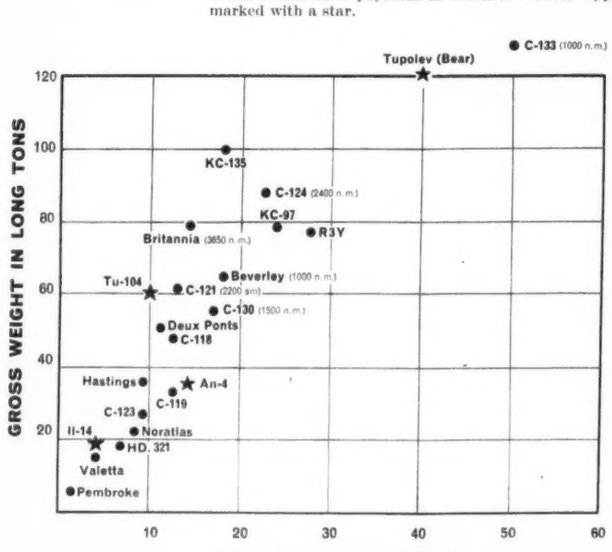




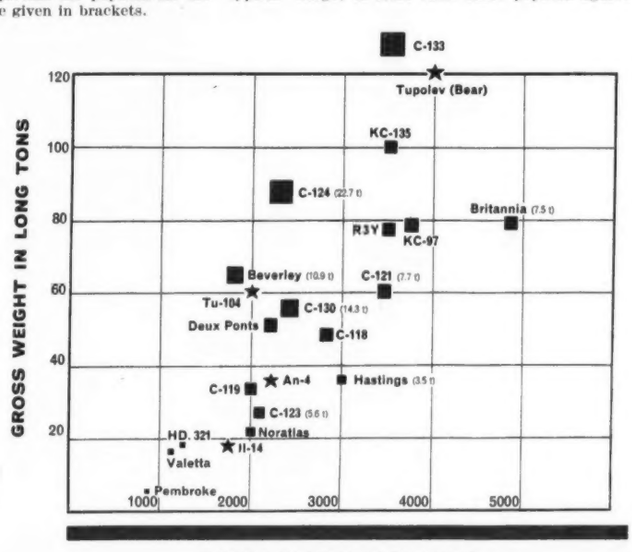




Typical payloads and maximum gross weights; distance covered with these payloads in brackets. — Soviet types are marked with a star.



Typical ranges with reduced payload and maximum gross weight. The square areas represent the payload for the "typical" range; in some cases exact payload figures are given in brackets.



livered to the U.S. Air Force's Tactical Air Command in December 1956. The aircraft (which is described in greater detail elsewhere in this issue) is in large-scale production for T.A.C. and M.A.T.S.

The following brief remarks on the older transport types, which have already been described on several occasions in these pages, supplement the diagrams.

A total of 888 Boeing C-97 and KC-97 transports and tanker/transports (four P & W R-4360 engines of 3,500 h.p. each) have been delivered to the U. S. Air Force, primarily to S.A.C. (KC-97E, F and G series) and secondly to M.A.T.S. (C-97A and C series).

Only slightly smaller in dimensions than its successor, the C-133, but with much less powerful engines (four 3,800 h.p. P & W R-4360s), the *Douglas C-124 Globemaster 2* strategic transport carries loads of up to 32 long tons in its double-deck fuselage, in particular 200 fully-equipped troops or 127 wounded plus attendants. Altogether 446 C-124s were delivered, the majority of them to S.A.C., the remainder to M.A.T.S.

The Douglas C-118 (Navy designation R6D) is a military version of the DC-6, uses the same P & W R-2800 engines and carries 80 troops or 60 wounded. Roughly 160 are in service with the U.S. Air Force and Navy.

Another transport with intercontinental range is the *Lockheed C-121* (Navy designations R7V) with four Wright R-3350 engines, the military version of the *Super Constellation*, which can lift 75 troops, 47 wounded or 13 tons of cargo. A *YC-121F* turboprop version (four P & W T-34s), which has been under test for two years, even carries 106 troops, 73 wounded and 16 tons of cargo.

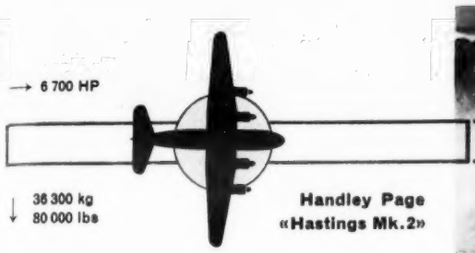
The *Fairchild C-119 Flying Boxcar* tactical transport (Navy designation R4Q) is fitted with two Curtiss-Wright R-3350 engines and carries supplies, parachute loads and paratroopers. Around 1,100 have been delivered, most of them to the U.S. Air Force, to a smaller extent to the Navy.

● European transports

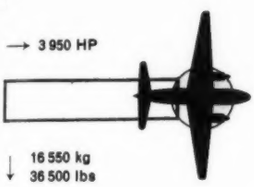
The military transports at present in service with the West European Powers are inadequate in both numbers and carrying capacity, as the Suez conflict has shown. In particular, R. A. F. Transport Command's standard types—the four-engine *Handley Page Hastings* and the twin-engine *Vickers Valetta*—are completely obsolescent, the one being an "adapted" bomber (H.P. *Halifax*), and the other a converted civil type (Vickers *Viking*).

France, on the other hand, has a useful tactical transport in the Nord 2501 *Noratlas*, though this is still not available in sufficient numbers (something

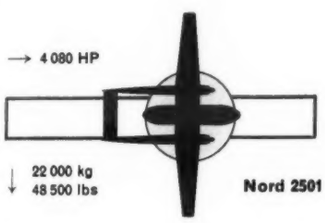
European transports in service



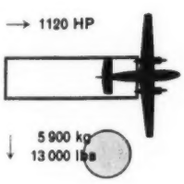
Handley Page «Hastings Mk.2»



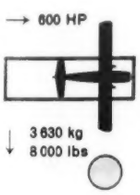
Vickers «Valetta Mk.1»



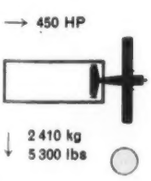
Nord 2501 «Noratlas»



Hunting Percival «Pembroke C.1»



DHC-3 «Otter»



Holste MH. 1521 «Broussard»

like a hundred have so far been delivered; only 25, however, are said to have appeared over Port Said), and Britain's Blackburn *Beverley* (some 20 of which have been delivered up to the present) also seems suitable for tactical transport operations over short and medium distances. It remains to be seen how much money can be negotiated for additional aircraft of these types. More than 100 Nord 2501s are, for example, to be built under licence in West Germany.

The only strategic transports available in Western Europe at present are mere stopgaps. R.A.F. Transport Command, for example, will get ten *de Havilland Comet 2s*, which fly with reduced pressurization, and the French Army has from time to time chartered some of the seven SE. 2010 *Armagnacs* belonging to private companies, e. g., for the Indo-China airlift. Some slight improvement in the situation can be expected when the Bristol *Britannia 250* (13 ordered for the R.A.F.) and the Breguet *Deux-Ponts* (15 ordered), both strategic transports now under construction, are delivered.

The Bristol *Britannia 250*, with four Bristol *Proteus 755* propeller turbines, will combine high cruising speed (over 320 knots) with unusual range (more than 4,850 nautical miles) and be capable of carrying 14 long tons of cargo or roughly 100 troops. It will have large loading doors in the nose and rear fuselage, to take guns and vehicles. A modified version of the *Britannia* (with different engines) is under development at Canadair Ltd., Montreal, under the designation *CL-44*.

The *Breguet 765 Deux-Ponts*—the original project for which goes back to 1948—is designed to make optimum use of available space. So far, however, because of lack of funds, it has been built only in civil form (Air France has twelve; designation Breguet 763 *Provence*). The lower deck of the military version can be loaded with heavy cargo via the tail ramp, while troops—or lighter freight—are carried on the upper deck.

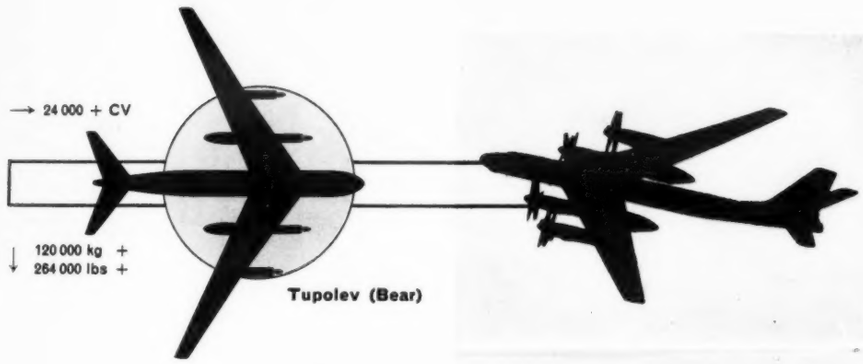
Finally mention should be made of the *Hurel-Dubois HD. 321* high aspect-ratio wing cargo aircraft, which is designed for optimum L/D ratio and increased economy. This aircraft could probably be used for supply work outside the combat zone or in colonial service, particularly as it can take off and land on grass runways and has a very short take-off run. Transport capacity 44 men or 6 long tons of freight.

● American and European small transports

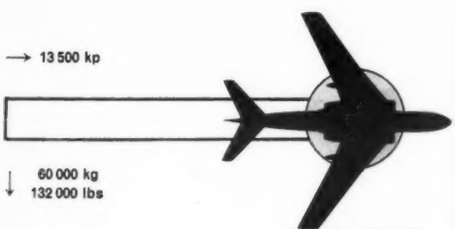
Military transport duties in areas that are difficult of access, such as the Arctic wastes or the Malayan jungle, are performed not only by helicopters but also by fixed-wing aircraft. These, however, must combine low wing loading with high engine power. De Havilland Canada's two "bush transports", the *DHC-2 Beaver* and *DHC-3 Otter*, for example, have been in service for a number of years with the U.S. Air Force, the R. A. F. and the R. C. A. F. The *Beaver*, fitted with a P & W R-985 engines (450 h.p.), can carry up to 7 men over distances of around 900 miles, the *Otter*, with a P & W R-1340 engine (600 h.p.), up to 12 men. Designed for the same purpose and powered by P & W R-985s, France's *Max Holste MH. 1521 Broussard* carries only 6 men (including pilots) or 1,200 lbs. of payload. Roughly 300 of these aircraft are in production.

Finally there is the *Hunting Percival Pembroke C* twin-engine short-range transport (two 560 h.p. Alvis *Leonides*), which is in service not only with the R.A.F. but also with the Belgian, Danish, Finnish and Swedish air forces and lifts up to 12 persons or roughly 1,760 lbs. of payload.

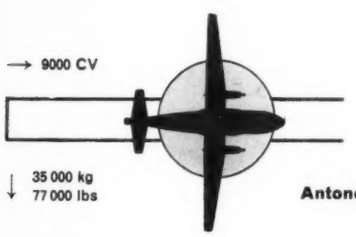
The Red Army's Air Transport Fleet ...where known



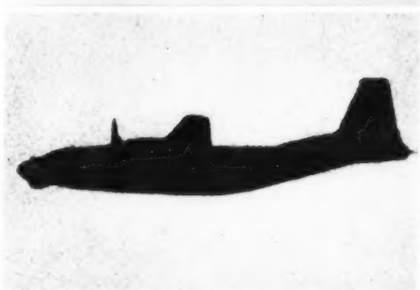
Tupolev (Bear)

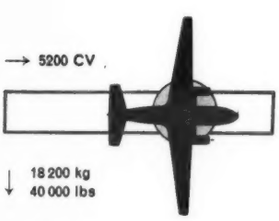


Tupolev Tu-104

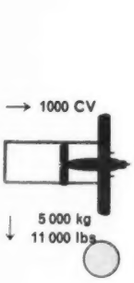


Antonov An-4





Iljuschin Il-14



Antonov An-2

(For scale see p. 108 etc.)

The Soviet Union has of late been making strenuous efforts to modernize its air transport fleet. Though it had impressive numbers of Ilyushin Il-12 and Il-14 medium-range transports, it was, up to a very few years ago, almost entirely lacking in efficient long-range and assault transports. Today, however, the Soviet Air Force has received new Tupolev and Antonov aircraft, which could be used as military transports and which, like the more recent American models, are turbine-powered.

The *long-range turboprop transport* which the Soviet press announces as derived from the Tupolev turboprop bomber (N.A.T.O. designation *Bear*), is believed to have similar dimensions to the bomber, namely a span of roughly 184 ft. and a length of roughly 147 ft. The bomber's slender fuselage has probably been replaced by a larger, double-deck fuselage, and gross weight may be estimated to exceed 120 to 140 tons. Power is supplied by four super-powerful propeller turbines with contra-rotating propellers. Thus as regards payload and transport capacity this swept-wing transport is doubtless comparable to the Douglas C-133, and may even be superior as regards speed. A tanker version for the in-flight refuelling of Soviet long-range bombers is probably also planned. The high aspect ratio wing and super-powerful turboprops suggest high altitude performance similar to that of the four-jet *Bison*.

The *Tupolev Tu-104* jet commercial transport is also believed to be planned in a military version for the Soviet Air Force. The data for the civil version published by the Russians reveal, however, that the Tu-104 is not suitable either for real long-range operation or for the carriage of high payloads. At any rate the Russian aircraft does not fare too well when compared with the Boeing KC-135, since it is capable merely of carrying roughly 6 tons of payload over a distance of 1,900 nautical miles (at a speed of 445 knots). However, it could be used successfully for moving command personnel and elite troops.

At the Soviet Aviation Day, in June 1956, a hitherto unknown assault transport by the Soviet designer *Antonov* was demonstrated (Russian designation An-4). This aircraft is only slightly larger than the Fairchild C-123, but has more powerful engines. The two Kutsnetsov propeller turbines are said to deliver nearly 4,500 h.p. each. This would not only make the An-4 faster than the C-123 but also enable it to carry greater payloads.

The Red Army's standard transports are still the Ilyushin Il-12 and Il-14, both of which are also used as commercial airliners. They are available in sufficient numbers to enable their relatively low transport capacity to be made good by mass operations. Their operational reliability and ease of maintenance are today beyond doubt, and they could render valuable services as paratroop and supplies transports.

Like Canada's small *Otter* and *Beaver*, the large, rugged Antonov An-2 biplane falls into the category of "bush transports", though it can carry 15 fully-equipped troops. Good high altitude and low-speed qualities make it particularly suitable for mountain operations.

Rotary Wing Transports in West and East

United States

● The *Sikorsky S-56* twin-engine assault helicopter (U. S. Army designation H-37, U. S. Navy HR2S-1) is being built in large numbers (altogether about 250) for the U. S. Army, under a production programme covering several years. The Marine Corps has also ordered more than a hundred HR2S-1s. The helicopter carries roughly 5 tons of payload (for example, three small cross-country vehicles) or 26 fully-equipped infantrymen, and has nose loading doors. Two 2,100 h.p. Pratt & Whitney R-2800 two-row radial engines in nacelles drive a five-blade rotor; centre of gravity travel is compensated by the horizontal stabilizer at the rear of the fuselage.

● The *Sikorsky S-58* transport helicopter (U. S. Army H-34, U. S. Navy HSS-1), a development of the well-known single-engine S-55, with 1,640 h.p. Wright R-1820 engine, is now in production. It differs from its predecessor in its larger fuselage (with rear portion opening sideways) and in its new rotor transmission system. It carries approximately 1.8 tons of payload or 12 fully-equipped troops over a distance of 100 miles. With a reduced payload its range is 270 miles, with auxiliary tanks as much as 950 miles.

● The U. S. Air Force's (and U. S. Army's) standard helicopter is the *Vertol H-21*, which has acquired a reputation as a flexible assault transport capable of carrying a shock unit of 20 men and—on tow cables beneath the fuselage—cross-country vehicles or guns. The U. S. Air Force and Royal Canadian Air Force used the H-21 in the construction of the Mid-Canada Line of early warning radar stations; the French Army uses it in Algeria. The two three-blade rotors are driven by a 1,425 h.p. Wright R-1280 in the fuselage rear; range more than 450 miles. An experimental H-21D version with two General Electric T-58 gas turbines, now being tested, promises to have greater cruising speed, ceiling and payload.

● Two prototypes of the twin-engine *Vertol YH-16* were designed as heavy cargo and troop transports, one with 1,650 h.p. Pratt & Whitney R-2180 piston engines, the other with 3,000 h.p. Allison T-36-A6 gas turbines. The vast cargo compartment has room for three jeeps or 40 troops; the loading ramp is in the rear.

U.S.S.R.

● The *Yakovlev Yak-24* large twin-rotor helicopter shown at Tushino in 1955 and 1956 is in quantity production. It carries 40 troops or several jeep-type vehicles towing anti-aircraft or anti-tank guns. The two four-blade rotors are driven by two 1,850 h.p. ASh-82 radial engines, one in the nose and one in the rear.

● The Red Army has also for several years been using the single-rotor *Mil-4*, whose general configuration recalls the Sikorsky S-55. Power plant is a 1,850 h.p. ASh-82 radial in the fuselage nose. Contrary to the American type, the Mil-4 has its loading doors in the rear.

Great Britain

● Five prototypes of the twin-engine *Bristol 173* (picture) have so far been built and submitted to extensive testing. A later development of the Bristol 173 (two 850 h.p. Alvis *Leonides Major* piston engines) is the *Bristol 192* military version with two 1,450 h.p. Napier *Gazelle* gas turbines and a gross weight of 18,000 lbs. It has been ordered in substantial numbers by the R. A. F. It is reportedly capable of carrying 18 to 25 fully-equipped troops or 600 lbs. of cargo at a cruising speed of 120 knots, or could also be used for the evacuation of wounded (12 stretchers, 3 seated patients, one attendant) and in the search and rescue service.

● Westland Aircraft Ltd. is building large numbers of the single-engine S-55 under licence from the Sikorsky Division of United Aircraft; British designation *Whirlwind MK. 5*. It is fitted with a 750 h.p. Alvis *Leonides Major* radial engine (picture).—Westland has also brought out, for the Royal Navy, the *Wessex* multi-purpose helicopter, which corresponds to the Sikorsky S-58 but is described by the manufacturers as a completely new design. Projected power plant is a Napier *Gazelle* gas turbine of roughly 1,450 h.p.; payload will be 2,000 lbs. inside the helicopter plus 4,000 lbs. in external loads. First deliveries are scheduled for 1958.

Airlift

M.A.T.S. at the Service of All

A Douglas C-124 *Globemaster*, one of M.A.T.S.' standard transport types, at Britain's Burtonwood base.

"The mission assigned to M.A.T.S. is of major strategic importance. It is more than just a convenient air transport system. It is a significant portion of our overall Air Defense Forces." This evaluation of the Military Air Transport Service by the House Appropriations Committee last year sounds almost like a vindication, as if M.A.T.S. had enemies and needed defending.

"Enemies" is perhaps too strong a word, but there is no lack of rivals and critics. The civil airlines follow with mixed feelings the impressive development of this international large-scale operator—which sends an aircraft across the Atlantic or the Pacific every 48 minutes, day and night, carries 900,000 passengers and 170,000 tons of freight a year and employs a civil and military staff of 100,000. Apart from the private airlines, there is also the U.S. Navy, whose air transport was to have been taken over entirely by M.A.T.S. under the original plan, but who has built up a very respectable fleet of large transport aircraft of its own and is jealously watching over its transport prerogatives and appropriations. As for the combat units of the U.S. armed services, it is still reportedly the practice, even among those who should theoretically know better, to look down somewhat on M.A.T.S.

However that may be, Congress felt obligated to stress anew the growing *strategic significance* of air transport (discussed in greater detail elsewhere in this issue). Anew, since all the essentials had already been said in the report of the Finletter Commission, which was appointed by President Truman in 1947 to study U.S. aviation needs and whose recommendations were set down in "Survival in the Air Age". On the subject of air transport the report concludes that the services' independent transport fleets, as they then existed, were not capable, even with the aid of commercial aircraft, of meeting probable military needs. ". . . We also recommend the consolidation of A.T.C. and N.A.T.S. into one Military Air Transport Service to handle all scheduled military transport services for the Army, the Navy and the Air Force."

M.A.T.S. commander Lieutenant General Joseph Smith took over the post at the end of 1951. Three years earlier he had worked under his predecessor, Major General L. S. Kuter, on the Berlin airlift.

Brief review of M.A.T.S. airlifts

The Finletter report was published at the end of 1947, M.A.T.S. came into being on June lst, 1948 . . . and six weeks later the commanding general, U.S.A.F.E., urgently requested eight transport squadrons (72 C-54s) for "Operation Vittles", the Berlin airlift. The energy with which M.A.T.S. launched itself into the operation, what it performed and how its contribution (more than 2,230,000 tons of supplies) played a decisive part in breaking the Berlin blockade now belong to history.

M.A.T.S.' constant readiness to intervene without great fuss wherever it is needed has remained unchanged during the past eight years.

Some of the most important data from M.A.T.S.' history are outlined below.

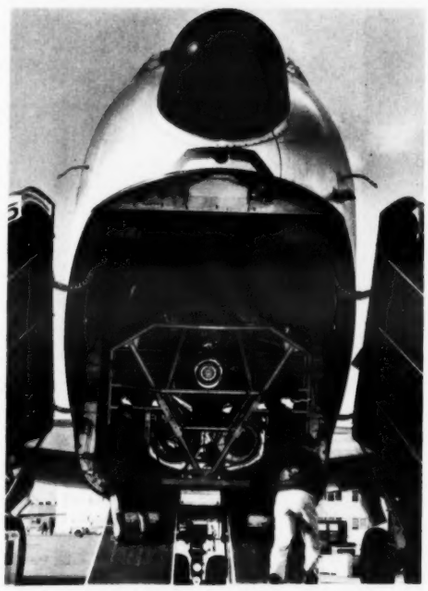
In November 1949 a M.A.T.S. C-74 *Globemaster I* was used for the first time on the trans-Pacific route. Seven months later, on June 25th, 1950, the Korean War broke out, placing the young organization before one of the most responsible tasks ever confided to a transport service. For the first time supplies had to be brought up by air as soon as the bomber and fighter units were deployed. Within a few hours of the attack on South Korea the Strategic Air Command's Pacific bases had to be kept supplied with everything needed for the Command's operations.

The Korean War lasted three full years (June 1950 to July 1953) and at times brought M.A.T.S. almost to breaking point. For example, no fewer than 95% of all

military patients—62,000 wounded and sick—were evacuated to the United States by air. Nevertheless, M.A.T.S. also successfully completed a series of other operations during the same period.

Early in the Spring of 1951, for instance, it began regular flights to the American base then under construction at Thule, Greenland. Three thousand engineers and construction workers, prefabricated huts, bulldozers, tractors, diesel engines, cranes, fuel—with the exception of the very heaviest freight, everything needed for building the base was moved by air. And during the Winter of 1951—52, when Baffin Bay and Davis Strait were blocked by ice, M.A.T.S. airlift alone supported the U.S. Air Force base at Thule and the new base being built at Söndre Stromfjord, delivering cargo and personnel at the rate of over 900 tons a month.

Alongside these operations, M.A.T.S.' "routine work" continued unchanged. In March 1952 the first Republic F-84 *Thunderjet* fighters for the European N.A.T.O. units had to be flown from the United States to bases in France. Organization of the 4,000 mile flight from Labrador via Greenland, Iceland and Scotland to France was entrusted to M.A.T.S. This was followed in the second half of July the same year by "Operation Hop-a-long", the initial trans-Atlantic flights of H-19 helicopters, some under very adverse weather conditions. All helicopters were delivered unharmed in Europe. Scarcely was this task completed when the Government of Lebanon appealed for help in moving 3,800 Mecca pilgrims who had been stranded in Beirut. M.A.T.S. sent 14 transport aircraft, which operated a shuttle service between Beirut and Jedda, carrying 50 passengers a time, and within four days had set down the last pilgrim on holy soil.



The *Globemaster's* loading doors open wide as a barn to let pass, without the slightest difficulty, a power plant from the B-36 bomber.

Ambulance services between Korea and the United States. The *Stratofreighter* has room for 79 stretchers.

The repatriation of American prisoners-of-war from North Korea (May 1953), the evacuation of French wounded from Indo-China to France (July 1954), assistance to Italy during the Po Valley floods (Spring 1955) the carriage to Naples of United Nations troops for Egypt (November 1956), the transport of Hungarian refugees to the United States (December 1956) . . . wherever and whenever urgent transport tasks have to be performed in national or international interests, M.A.T.S. is called upon for assistance as a matter of course. It is therefore not surprising to find that the Service made roughly 100,000 ocean crossings between 1948 and 1956 (46,733 Atlantic and 61,493 Pacific crossings), of which more than 22,000 (12,348 Atlantic and 10,068 Pacific) were made in 1956 alone. The following transport figures were published at the end of 1956:

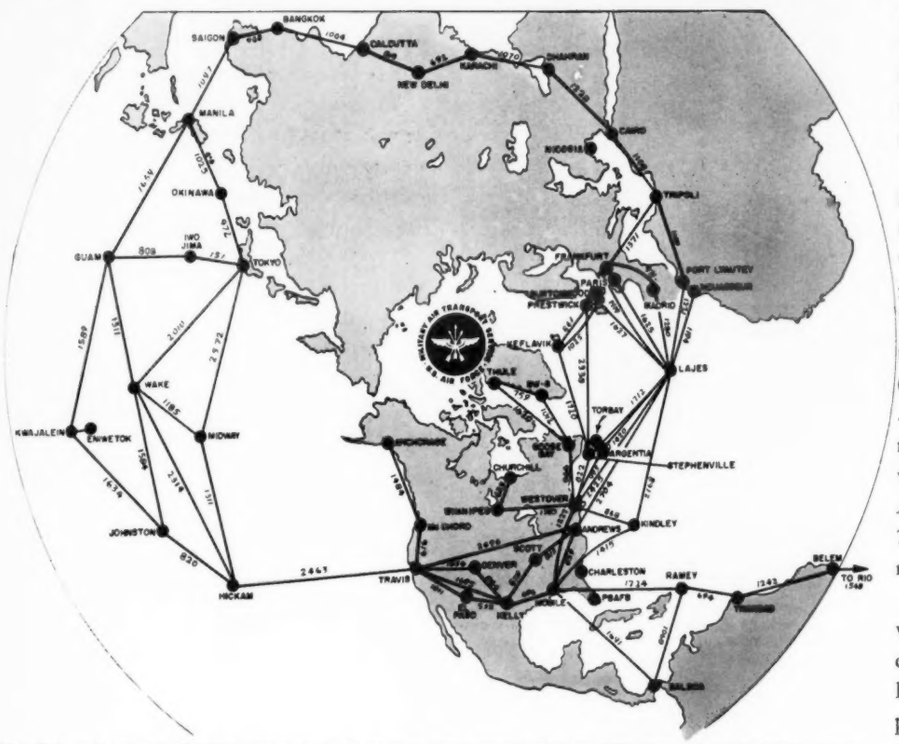
	1956	June 1st, 1948 to December 31st, 1956
Passengers (incl. civil and military patients)	862,689	4,314,462
Cargo and mail (short tons)	168,852	767,841
Passenger-miles	2,885,501,806	11,675,970,634
Cargo ton-miles	810,735,660	3,310,080,226

Missions and organization

Impressive as are the airlift services, they are by no means the only activity of this versatile organization. Headed today by Lieutenant General Joseph Smith, M.A.T.S. comprises five major branches: the transport divisions and four technical services, the Airways and Air Communications Service, Air Rescue Service, Air Weather Service and Air Photographic and Charting Service.

"M.A.T.S. . . . is a significant portion of our overall Air Defense Forces": A 27-ton U.S. Army L-37 tank being unloaded from a *Globemaster* at McChord AFB, Washington.

The Boeing C-97 *Stratofreighter* long-range transport can lift no fewer than eight engines of this size. Fitted with four Pratt and Whitney *Wasp Majors*, the *Stratofreighter* has a cruising speed of 300 m. p. h.



M.A.T.S. route network. M.A.T.S. runs only ten bases on its own account: Kindley AFB, Bermuda; Lajes Field, Azores; Keflavik, Iceland; McGuire AFB, New Jersey; Dover AFB, Delaware; Palm Beach AFB, Florida; Charleston AFB, Andrews AFB, Washington, D. C.; Orlando AFB, Florida; Prestwick, Scotland. At all other bases marked on the map M.A.T.S. is only a "lodger" with American or other air force units.

The transport command proper, the main branch, is responsible for all air transport of military personnel (including sick and wounded), mail, weapons and other cargo for the armed services and certain civil agencies. One of its prime responsibilities is support for Strategic Air Command. The transport mission is accomplished by three divisions: Continental Division with headquarters at Kelly AFB, Texas; Pacific Division with headquarters at Parks AFB, California; and Atlantic Division with headquarters at McGuire AFB, New Jersey.

The *Airways and Air Communications Service,* with headquarters at Andrews AFB, Washington, D.C., a world-wide communications system, is in a sense the military counterpart to the Civil Aeronautics Administration. It provides all U.S. Air Force aircraft with navigational aid facilities and air traffic control services. A.A.C.S. operates more than 2,000 facilities, employing more than 27,000 military personnel and stretching from Alaska to the Panama Canal, Greenland to the West Indies, Europe to the Pacific. Major stations handle more than 3,000,000 messages a month.

The *Air Rescue Service,* with headquarters at Orlando AFB, Florida, which celebrated its tenth anniversary on May 29th, 1956, comes to the aid of all military and civil aircraft in distress, regardless of nationality. During the past ten years 20,647 persons have been rescued by A.R.S. personnel, 4,078 of them from certain death.

One practical example: in the Spring of 1956 a Northwest Airlines *Stratocruiser* crashed into the icy waters of Puget Sound shortly after taking off from Seattle-Tacoma International Airport. The low water temperature made speed essential. According to a United Press report, "The rescue, one of the fastest on record, was completed only a few minutes after the double-deck, four-engine plane went down about half way between Seattle and Tacoma".

Hungarian refugees, flown from Europe by M.A.T.S., receiving an address from a U.S. Army chaplain on arrival at Palm Beach AFB, Florida.

Two SA-17 *Albatross* rescue amphibians were able to save 32 of the 37 persons aboard, and when the survivors tried to thank their rescuers, the latter waved them aside, saying it was "all in the day's work".

The *Air Weather Service* operates a close-linked system of weather facilities throughout the Northern Hemisphere, using a world-wide facsimile and teletype network for the transmission of weather data. Weather service aircraft make regular flights in the Arctic, the west Pacific (typhoon warning), in the Gulf of Mexico . . . in all regions where the weather is made. The first flight over the North Pole was made in March 1947, since when A.W.S. aircraft have flown more than 1,500 flights within approximately 300 nautical miles of the Pole.

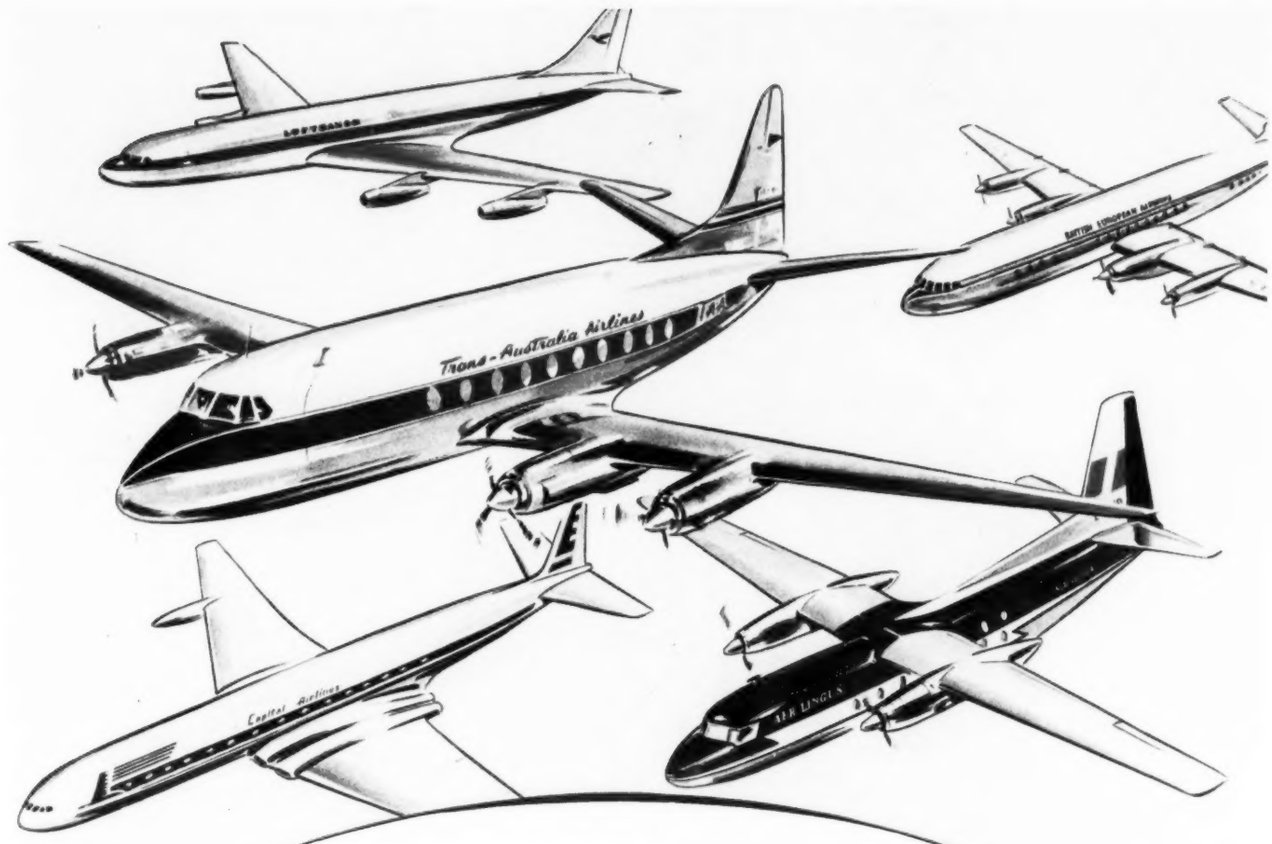
The *Air Photographic and Charting Service,* with headquarters at Orlando AFB, Florida, developed from the Army Air Force Air Pictorial Service. Its duties include the production and storage of stills and motion pictures, maps and charts, route handbooks and other aids to navigation, and the accomplishment of aerial mapping and geodetic surveys on a world-wide scale.

Development still only at the beginning?

Such are, in broad outline, the tasks and accomplishments of the Military Air Transport Service. Its fleet at the end of 1956 comprised roughly 500 four-engine and an estimated thousand or more twin-engine aircraft. In the near future its capacity will be greatly strengthened by giant new Douglas, Lockheed and Boeing jet or turboprop transports.

Whether the M.A.T.S. organization in its present form is really adequate to ensure full mobility for the U.S. forces within the framework of a global "atomic strategy" is another question. Opinions are widely divided on this point, and serious concern has been expressed in view of experience in Korea, Indo-China and the Middle East.

In this connection some interest attaches to a project that was under discussion at the Pentagon in mid-December 1956. The office of Assistant Secretary of Defense for Supply and Logistics Thomas P. Pike is studying plans to turn 200 two- and four-engine Navy Fleet Logistic Air Wing transports over to M.A.T.S. and thus to give the latter the military monopoly recommended in the 1947 Finletter report.



The World's Airlines
have ordered
seven types of airliners
powered by

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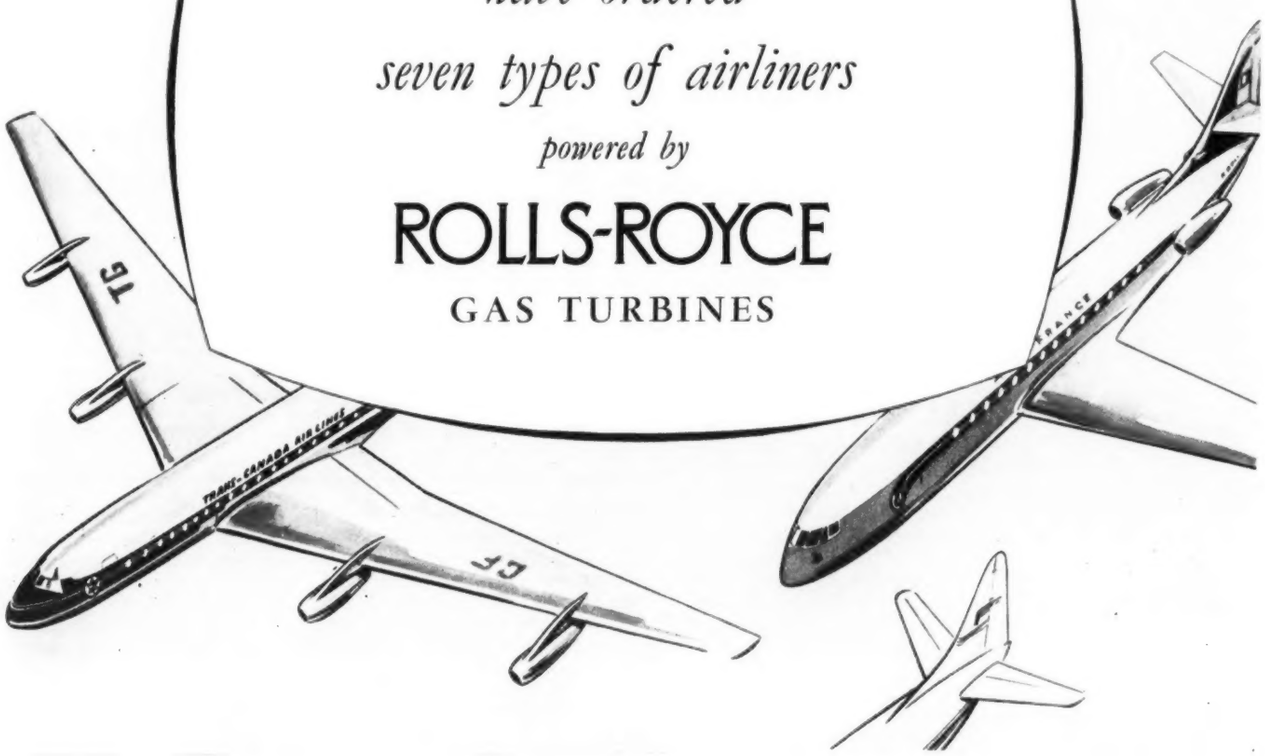
GAS TURBINES



ROLLS-ROYCE AERO ENGINES LEAD THE WORLD

Jet airliners shrink globe . . .

When you and your family board these new jet airliners, you'll be stepping into a completely new era of transportation designed to get you where you are going faster, more comfortably and more dependably. To appreciate the progress that has been made, following are some exclusive jet problems that had to be licked and some original answers to those problems worked out by Bendix Aviation Corporation.

For example, the starting, generating and ignition systems used on reciprocating engines were not applicable on jets. One of our new Bendix jet starters, small enough to put in a breadbox, produces 450 h.p. to crank a giant jet engine 1800 r.p.m. in three and a half seconds.

Igniting a jet is like lighting a match in a tornado. An ordinary spark has no chance. New Bendix jet ignition produces a super spark that fires jet engines immediately.

Jets are fuel hogs with very sensitive digestive systems. Not too much, not too little—the mixture's got to be just right. Speed, temperature and altitude affect this mixture. Thus, fuel-air proportions must be changed rapidly and automatically. New Bendix* fuel-metering and engine control systems are precise and automatic, take another tough problem off the crew's backs.

Jet speeds necessitate more accurate navigation and piloting. Here several exclusive Bendix devices team up for greater precision: The

ADVANTAGES OF THE JET AGE WILL BE JET PROBLEMS—HAS

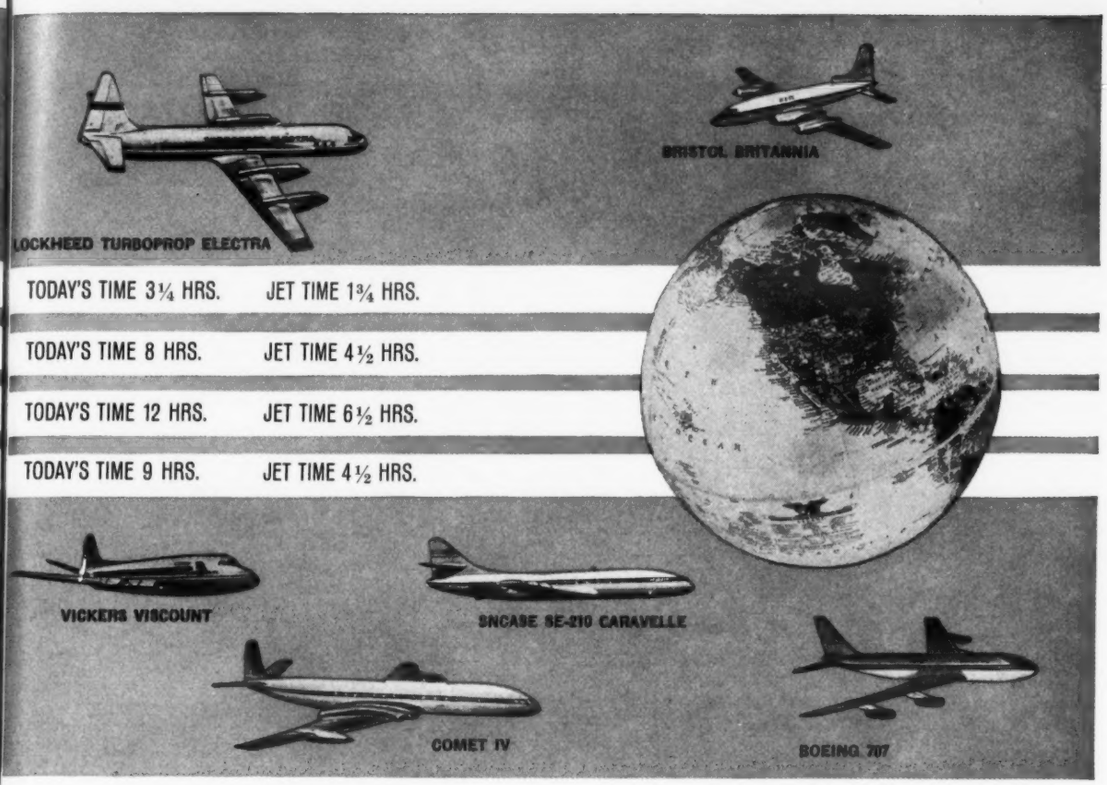
COMPLETE TRANSISTORIZED NAVIGATION AND CONTROL SYSTEM
Includes automatic pilot capable of automatic landing approaches; Flight Director systems; heading reference systems.

AIRBORNE RADAR SYSTEM
Sees storms 150 miles away and shows how to avoid them for smoother ride.

RADIO COMMUNICATION SYSTEM
Including receivers, transmitters, flush antennae, radio compass, radio magnetic indicators, marker receivers, glide slope receivers, VOR-localizer receivers, Omni-mag indicators, cockpit loud speaker, distance measuring equipment, transponder beacon and selective calling, passenger address and transistorized interphone systems.

LIQUID OXYGEN SYSTEM
Automatic high-altitude oxygen system for passengers plus flight crew oxygen system.

SPECIAL INSTRUMENTS
To measure Mach airspeed and fuel flow; accelerometers; specially lighted turn-and-bank and rate-of-climb indicators.


LOCKHEED TURBOPROP ELECTRA
BRISTOL BRITANNIA
TODAY'S TIME 3¼ HRS. JET TIME 1¾ HRS.
TODAY'S TIME 8 HRS. JET TIME 4½ HRS.
TODAY'S TIME 12 HRS. JET TIME 6½ HRS.
TODAY'S TIME 9 HRS. JET TIME 4½ HRS.
VICKERS VISCOUNT
SNCASE SE-210 CARAVELLE
COMET IV
BOEING 707

. . will cut travel time in half!

YOURS SOONER BECAUSE BENDIX ANTICIPATED THESE DEVICES READY NOW

COMPLETE LANDING GEAR
Including wheels, brakes, shock absorbers and "Cerametalix" brake lining—our special friction material developed for stopping jets.

TURBINE STARTERS
Originated by Bendix to solve the problem of starting jet engines.

AC GENERATING SYSTEM
Including fault-detecting and regulating devices and inverters.

RELIABLE, RUGGEDIZED ELECTRON TUBES

JET IGNITION SYSTEM
Provides extra hot spark for starting and high altitudes.

FUEL-METERING AND ENGINE CONTROL SYSTEM
Provides proper air-fuel mixture at all speeds, temperatures and altitudes.

HYDRAULIC CONTROLS
For raising and lowering landing gear, applying boost power to control surfaces. Includes servo-valves, accumulators, positioning actuators, pressure reducers, relief valves, hand pumps, flow dividers and cylinders.

Polar Path* compass, which made polar navigation practical and which is equally accurate anywhere; the Flight Director, a simplified navigation system in which two instruments replace many; and the first completely transistorized automatic pilot which will not only fly jets with more exactness than human pilots but automatically bring them in for pinpoint landing approaches.

Ordinary brakes and lining can't stop the fast, heavier jets. New Bendix* jet airplane brakes and our special Cerametalix* friction material licked the stopping problem. New Bendix* landing gear and shock absorbers set them down softly.

Airborne radar to spot storms ahead, surveillance radar to help control airport traffic, G. C. A. radar for bad weather landings, a complete line of ground and air radio communications systems and automatic liquid oxygen systems are some of the other proven devices we have ready now for passenger jets.

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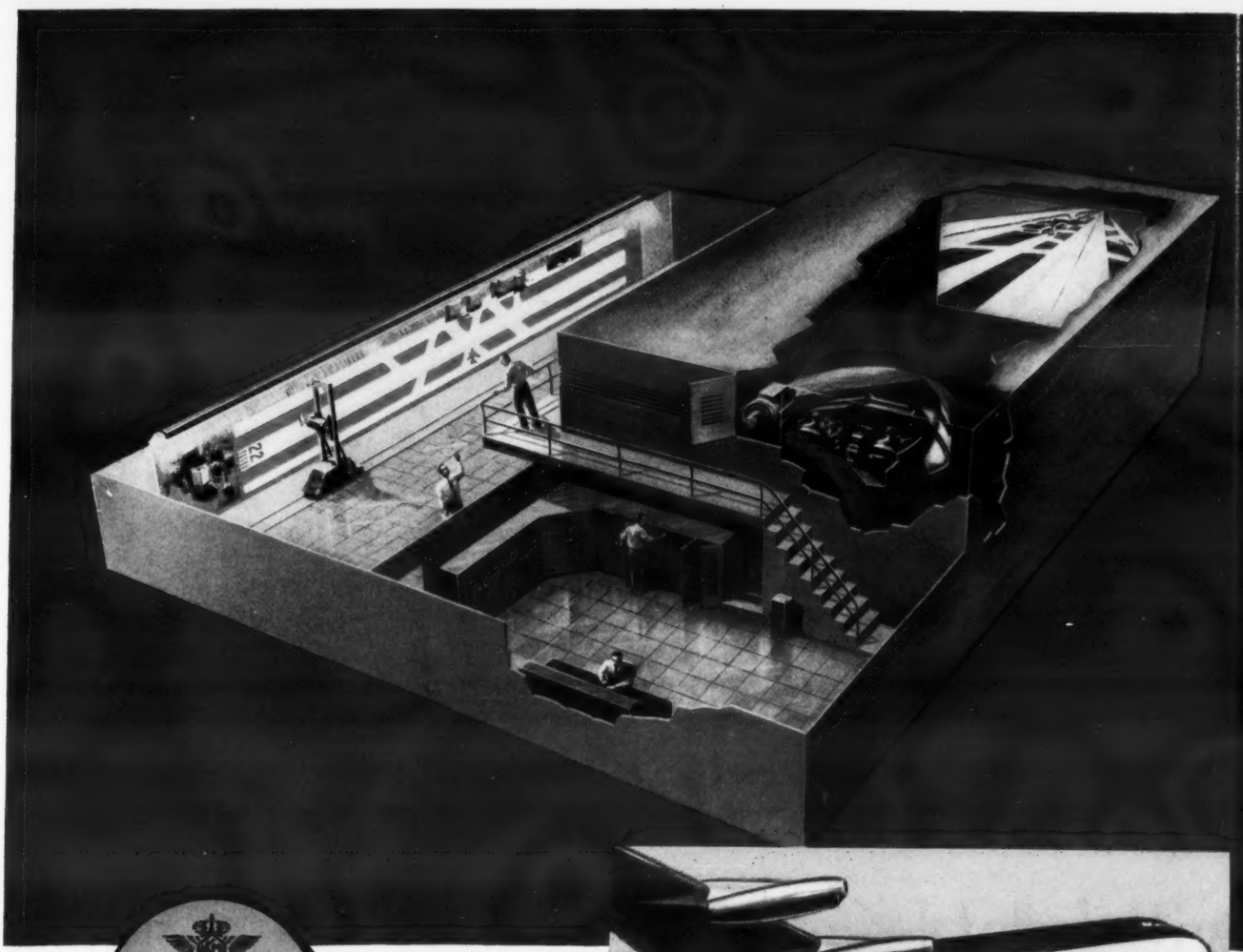
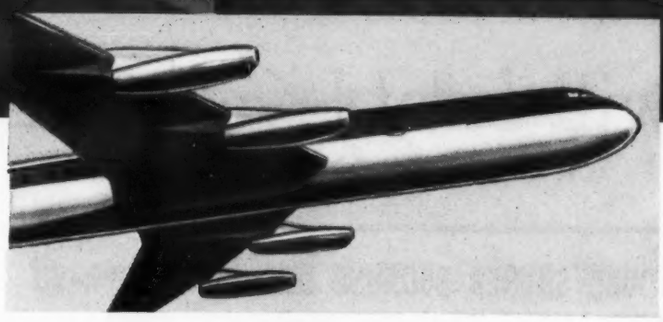


KLM
ROYAL DUTCH
AIRLINES

selects



LINK DC-8 *flight simulator*

To help train pilots and crews in transoceanic jet flight, Link will build KLM-Royal Dutch Airline's DC-8 jet flight simulator.

Long before the first of these mighty four-jet Douglas transports is delivered, KLM's personnel will have already learned the "feel" of the plane. They will have trained in conditions precisely simulating actual flight, practicing crew coordination, radio procedures, navigation, landings, takeoffs and the handling of emergency conditions.

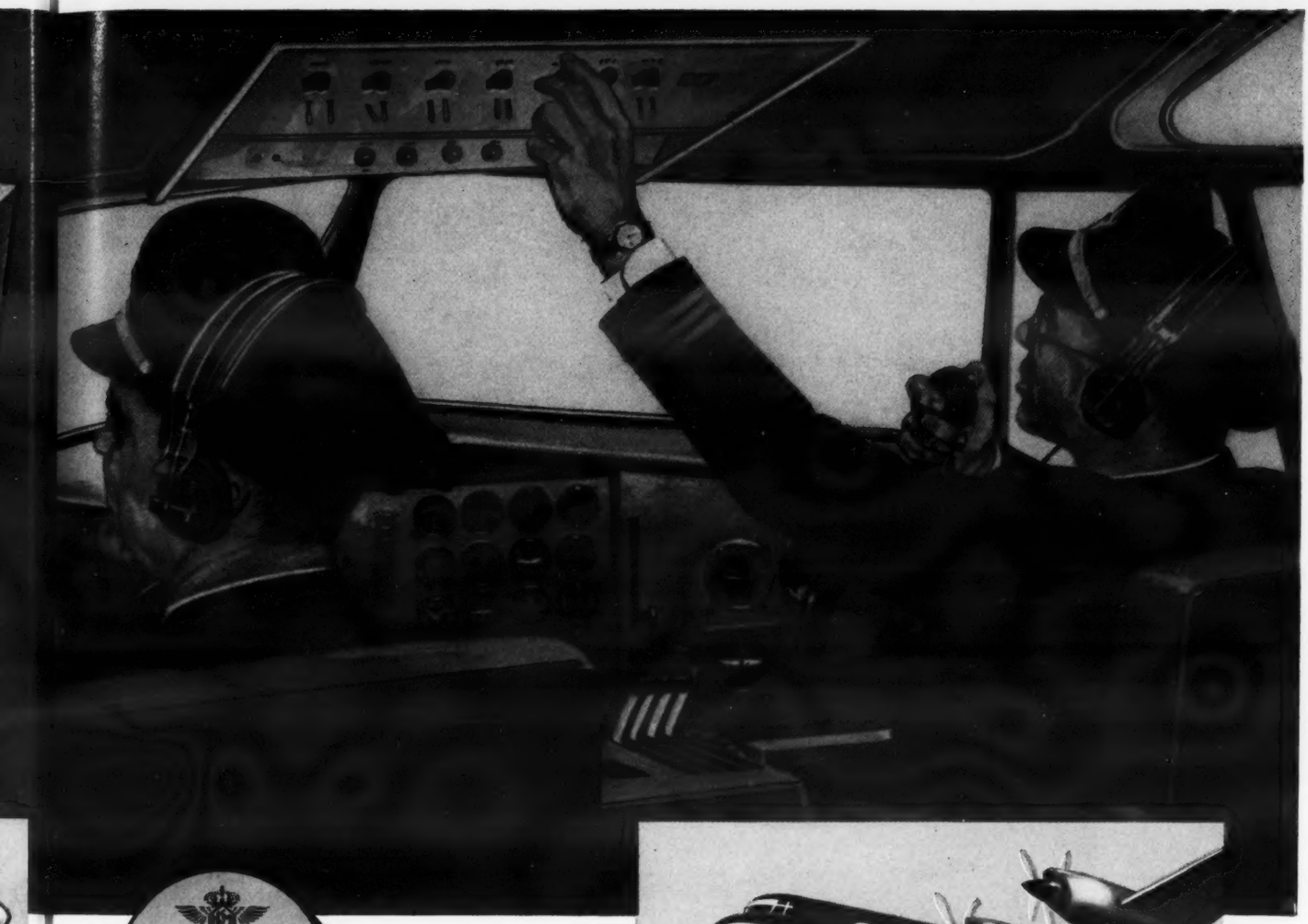
Keeping pace with progress in every field of aviation is the watchword at Link . . . where advanced electronic engineering is helping to make tomorrow's flight better and safer than ever before.

OTHER LINK DC-8 SIMULATOR USERS

UNITED AIR LINES

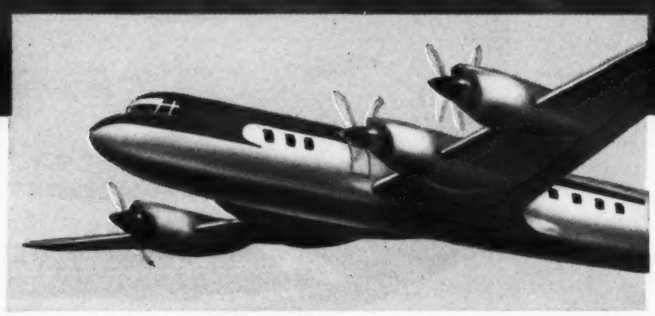
SAS SCANDINAVIAN AIRLINES SYSTEM

LAS



KLM ROYAL DUTCH AIRLINES

pilots



will train in LINK Electra simulator

The world's first Electra simulator has been designed and developed by Link. Pilots and crews for KLM-Royal Dutch Airlines' new Lockheed Electra fleet will train in this advanced propjet simulator . . . just as the personnel slated to operate KLM's new DC-8's will get the feel of jet flight in a Link DC-8 simulator.

By reproducing the cockpit and precise flight performance of the Electra in exact detail, Link engineering will make it possible for KLM personnel to experience actual "flight" in the new propjet. Long before KLM receives delivery, pilots and crews will have practiced and learned all flight procedures: landings and takeoffs, crew coordination, radio techniques and especially emergency procedures.

Once again, Link scores a major contribution in aviation progress . . . helping to build better, safer flight through advanced electronics engineering.

LINK AVIATION, INC.

Pioneer and World's Leading Producer of Flight Simulators

A Subsidiary of General Precision Equipment Corporation

Binghamton, New York

Forward thinking TCA *selects Collins Automatic*

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA, WASHINGTON, NEW YORK, DALLAS, BURBANK, SEATTLE, MIAMI

Pilot...

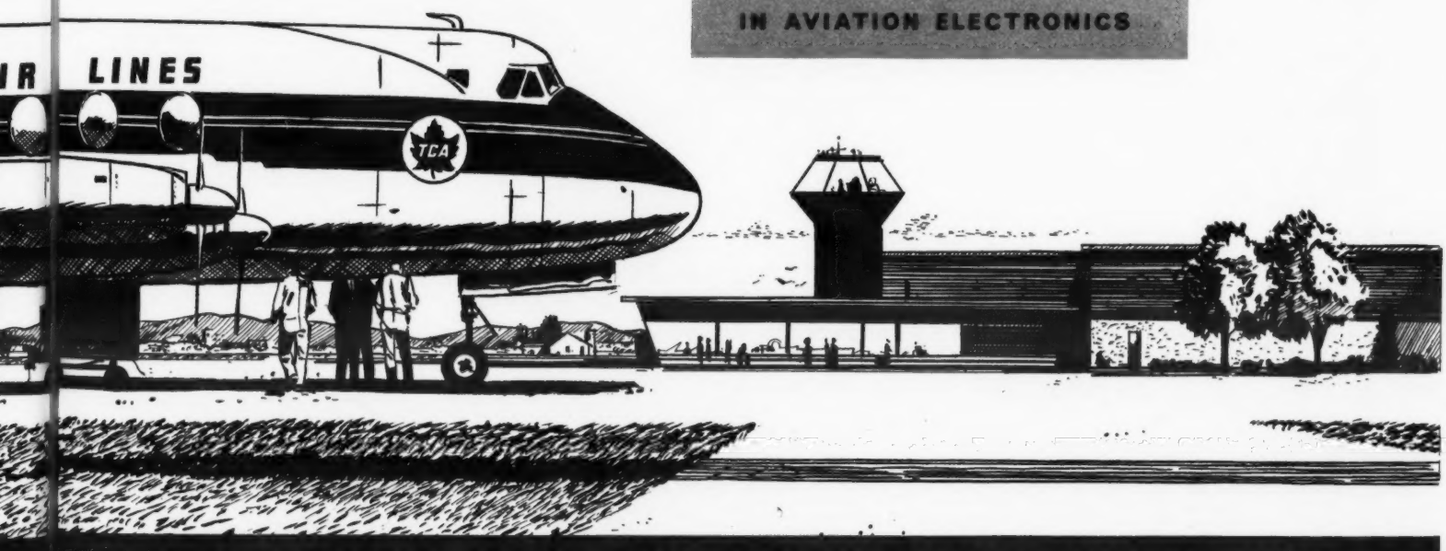
Installation of Collins Automatic Pilot System on Trans-Canada Air Lines' entire Viscount fleet has begun.

TCA chose the Collins System for its *compatibility*—combination of flight control with the original, time-proven "Integrated Flight System" provides monitoring by pictorial presentation on two easy-to-read instruments. *Smoothness*—designed for airline service, this System is refined with the latest techniques to assure smooth performance of maneuvers with positive control at all times. *Modularized*—packaged in modular plug-in type units for ease of maintenance.

Collins "combined" Automatic Pilot System is the natural choice of TCA.

Collins

CREATIVE LEADER IN AVIATION ELECTRONICS



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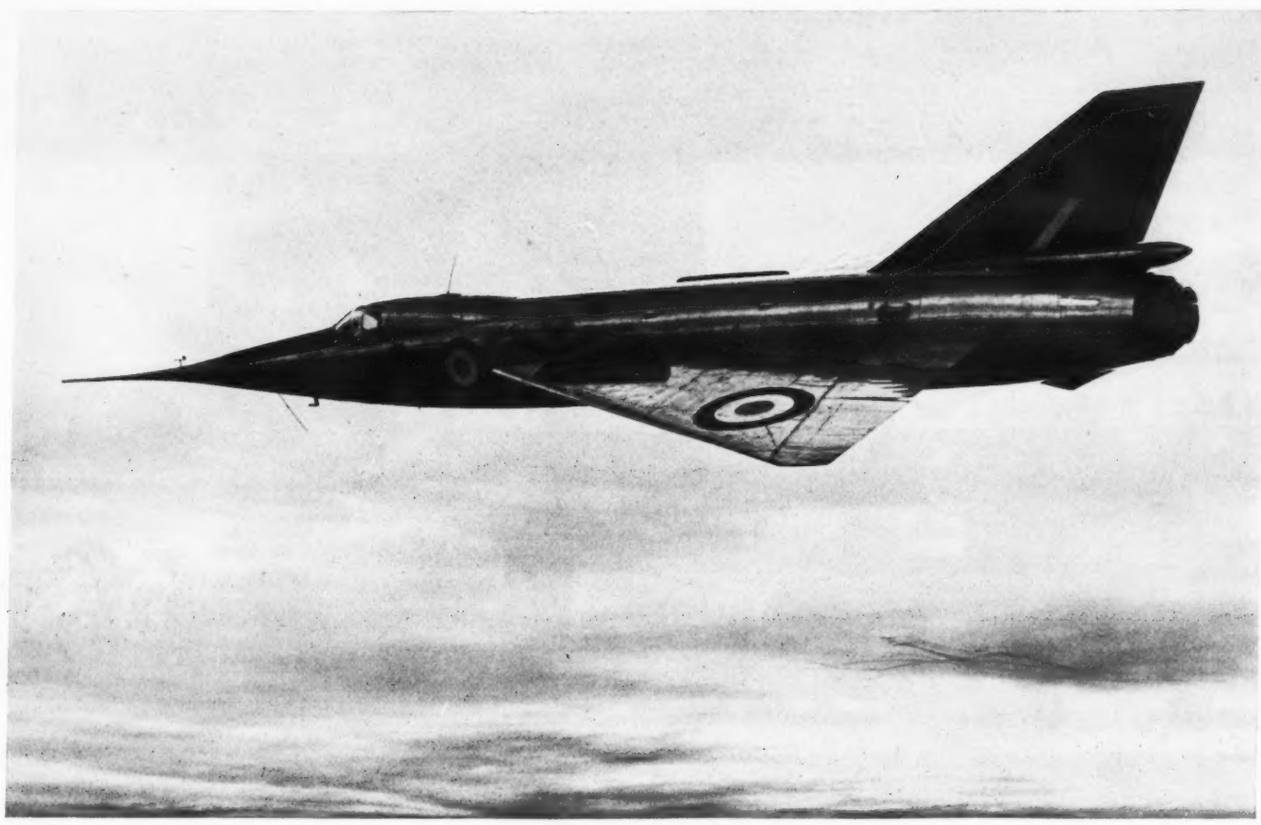
World's Fastest Jet



Powered by one Rolls-Royce AVON Jet Engine

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Lockheed C-130A *Hercules*

The delivery of the first production Lockheed C-130A *Hercules* multi-purpose tactical transports to the 463rd Troop Carrier Wing (Tactical Air Command) at Ardmore AFB, Oklahoma, at the end of 1956 marks a new chapter in military transport annals. Faster than any other transport in service, excellently instrumented (e.g. with airborne radar), pressurized, air-conditioned and de-iced, with intercontinental range . . . the C-130A can land and take off near the combat zone, if necessary even on grass fields. It has room for 92 fully-equipped troops, 64 paratroops or 74 wounded (on stretchers) plus attendants. Alternatively, it can lift loads of 25,000 to 37,000 lbs., from a self-propelled field gun to a 5,000-gallon F-6 airfield fuel truck.

This transport is of an amazing versatility. It is particularly suitable for the following missions.

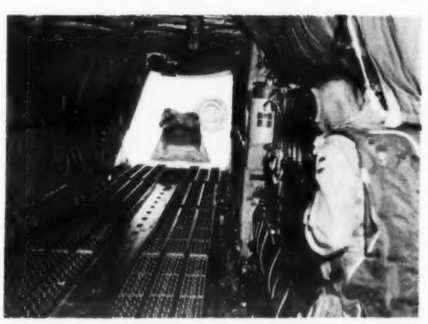
1 – *Airhead mission,* i.e., the transport of troops, weapons and ammunition into areas to be occupied or into combat zones. On this type of mission a 25,000-lb. load can be carried over a distance of 1,100 nautical miles, the last 200 nautical miles being covered in fuel-consuming low-level flight (1,000ft. above ground). The return flight (with 200 nautical miles again at low altitude) is made with no payload.

2 – *Resupply mission:* Here 25,800 lbs. can be carried over 1,300 nautical miles (or 37,800 lbs. over 950 nautical miles). The return flight is again made empty, but in this case without low-level stage.

3 – *Cargo mission:* Payloads of up to 37,800 lbs. over block distances of 1,500 nautical miles (or 25,800 lbs. over 2,520 nautical miles) at optimum cruising altitude.

4 – *Logistical support mission:* Payloads of up to 39,300 lbs. over block distances of 1,500 nautical miles (or 11,000 lbs. over 3,000 nautical miles) at optimum cruising altitude.

5 – *Freight dropping mission:* Payloads of up to 37,800 lbs. over a radius of action of 950 nautical miles (for outward and return flights) and release of cargo by parachute from medium altitude. (In all five cases a fuel reserve of 5% plus 30 minutes is allowed for.)

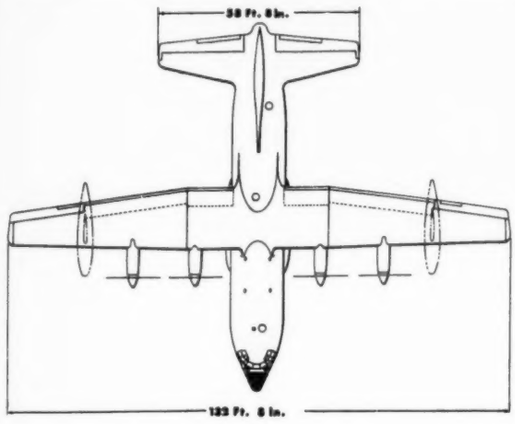


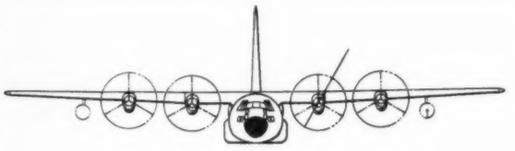
The extraction parachute moves a heavily loaded platform of supplies through the C-130A's rear door into the open air. Soon the main parachute (diameter 100 ft.) will open and carry the load – in this case 27,000 lbs. – safely to earth. Rollers are fitted in the floor and the front half of the door to enable the platform to be pushed to the rear with only moderate resistance.

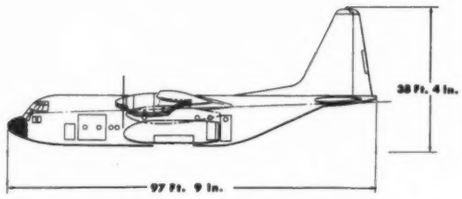
*

The C-130A is of shoulder-wing configuration with a straight, high aspect ratio (1 : 10) wing in three parts and a relatively short fuselage. As in the C-123, the rear fuselage curves upwards and ends in a large double door, the rear half of which opens upwards, the forward half being lowered to form a loading ramp. Because of its squat fuselage, the aircraft has very large vertical tail surfaces which make a very massive impression.

The C-130's cargo compartment is 41.5 ft long, 10.3 ft. wide and 9.1 ft. high. It has a volume of 4,300 cu. ft. and, thanks to its rugged floor, can carry a load of up to 1,080 lbs./sq.ft. Besides the two-part rear door, there is also a







DIMENSIONS OF THE C-130A

Span	132 ft. 8 ins.
Overall length	97 ft. 9 ins.
Height	38 ft. 4 ins.
Tailplane span	58 ft. 8 ins.
Propeller diameter	15 ft.
Wing area	1,745 sq. ft.
Aspect ratio	10.09
Cargo volume	4,300 cu. ft.

WEIGHTS

Max. gross weight	124,200 lbs.
Max. landing weight (for 8 ft./sec rate of descent on touchdown)	110,000 lbs.
Max. dry weight (for load factor of 2.5)	99,100 lbs.
Operating weight empty I (for airhead missions)	63,800 lbs.
Operating weight empty II (for resupply missions)	61,300 lbs.
Operating weight empty III (for cargo missions)	61,300 lbs.
Operating weight empty IV (for logistical support missions)	59,800 lbs.

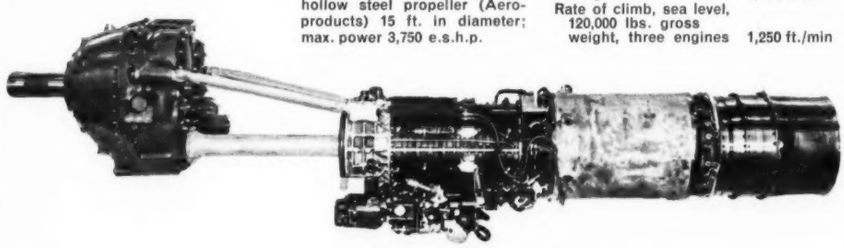
ENGINE PERFORMANCE
Four Allison T-56-A1

Take-off power at 13,820 r.p.m. 3,460 s.h.p. each plus 730 lbs.	15,000 e.s.h.p.
Max. continuous power (at 13,820 r.p.m.), 3,090 s.h.p. plus 700 lbs.	13,500 e.s.h.p.

PERFORMANCE

Max. cruising speed (at 20,000 ft.)	315 knots
Combat cruising speed (at 1,000 ft.)	290 knots
Take-off distance to 50 ft. with full take-off weight (124,200 lbs.)	3,150 ft.
Take-off distance with eight 100-lb. JATO rockets	2,700 ft.
Take-off run, as above, without JATO	2,000 ft.
Take-off run, as above, with JATO	1,600 ft.
Landing distance from 50 ft. with 110,000 lbs. landing weight, wheel brakes and reverse thrust	1,300 ft.
Landing run (as above)	1,100 ft.
Rate of climb at sea level, with 120,000 lbs. gross weight	2,400 ft./min
Rate of climb, sea level, 120,000 lbs. gross weight, three engines	1,250 ft./min

With 14-stage axial compressor (compression ratio 1:9.5), annular combustion chamber and four-stage turbine, the Allison T-56-A1 measures only 145 ins. from air intake to jet pipe end (excluding drive shaft and reduction gear). It is 27 ins. wide, 36 ins. long and weighs (with gear; without propeller) 1,750 lbs. The gear gives a reduction of 12.5:1, so that maximum propeller speed is only 1,060 r.p.m. Three-blade hollow steel propeller (Aeroproducts) 15 ft. in diameter; max. power 3,750 e.s.h.p.



The aircraft at low altitude with rear doors open.

wide loading hatch on the port side in front of the wing, as well as two doors, opening inwards, behind the wing for parachute jumping. The compartment, which is designed to carry not only cargo but also troops (seats provided), or wounded (light-weight stretchers permanently carried), is pressurized and air-conditioned. The pressurization system ensures a pressure corresponding to 8,000 ft. up to an altitude of 35,000 ft., and the air-conditioning system keeps internal temperature between 70° and 80° F, regardless of outside temperature. The system is operated by air bled from the engine compressors, which is either used hot or is cooled in a heat exchanger (with expansion turbine).

The flight station is equipped for four men: pilot, co-pilot, radio operator/navigator and systems manager. The last-mentioned, next in rank to the flight engineer, is responsible for the operation and maintenance of the engines and fuel systems, the hydraulic, electrical, pressurization, air-conditioning, de-icing systems . . . in short the whole technical side of this complex aircraft, while the two pilots and the radio operator/navigator are primarily concerned with their tactical tasks. Controls are power-boosted, and an autopilot is fitted as a matter of course; flight and engine instruments are arranged in front of the pilots, but in view of the systems manager (whose seat is raised); fuel controls, electrical switches, air-conditioning controls etc. are fitted overhead. The C-130's radio and navigation equipment comprises an airborne radar (AN/APN-59) for storm warning and navigation and for the recognition of marked dropping zones in bad visibility, as well as a periscopic sextant and the following radio equipment: UHF and VHF R/T, IFF, radio altimeter, radio compass, VOR receiver, glide slope receiver, VHF beacon receiver, LORAN receiver, emergency transmitter, intercom., Bendix public address system and Collins 618S-1 liaison communication system.

The power plant consists of four Allison T-56-A1 propeller turbines of 3,750 e.s.h.p. each and Aeroproducts reversible-pitch three-blade propellers. The fuel system comprises four integral tanks in the wing (total capacity 5,080 U.S. gallons) and two jettisonable auxiliary tanks beneath the wing (total capacity 2,800 U.S. gallons). For combat operations the whole fuel is pumped into the external tanks, so that the aircraft flies with "dry" wing in the event of contact with the enemy. Although in

normal operations each engine is supplied from its neighbouring tank, in special cases each of the six tanks can be connected to each of the four engines. Tanks are normally filled via a single point underneath the wings, though gravity refuelling points on top of the wing are also provided.

Landing gear comprises two main units with large diameter tandem wheels, retracted hydraulically — vertically upwards — into special housings on either side of the fuselage, and a hydraulically steerable nose wheel of conventional design, retracted forwards into the fuselage nose. Thanks to the rugged construction of the undercarriage and the use of large wheels with low-pressure tyres, the C-130 can operate on grass fields and sandy ground. It is also highly manoeuvrable on the ground, as the nose wheel can be steered through a full 60° on either side of centre.

The *hydraulic system* works on a pressure of 3,000 p.s.i. and operates the landing gear and locks, wing flaps, nose wheel steering, wheel brakes, flight control boosters and rear loading doors. Hydraulic fluid is normally supplied by pumps driven by the propeller turbines; a fifth engine pump and hand pumps are provided for use in emergencies.

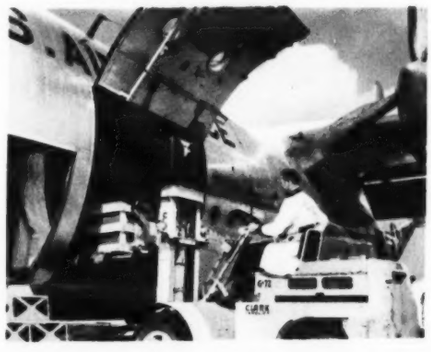
The *electrical system* is formed by five 28-volt, 400-Amp direct current generators, four of them driven by the turboprops, and the fifth connected to the auxiliary turbine motor. Each inboard engine also drives a 40 kVA three-phase alternating current generator. The engines are started — by means of compressed air — by the auxiliary turbine motor, which is itself started by a small battery. The latter is therefore comparable to the famous nail for want of which a horse and a kingdom were lost. Its care is particularly impressed on crews, since this battery starts the auxiliary motor, which starts the engines, which must bring the aircraft safely back from the airhead.

*

In conclusion it may be added that the C-130A is in large-scale production at Lockheed Aircraft Corporation Georgia Division's *Marietta* plant. The U.S. Air Force development contract was let in June 1951, the first prototype flew in August 1954, the first production aircraft in April 1955. The prototype was designed and built by the Burbank plant, while all subsequent development was the sole responsibility of the Georgia Division.

Despite its weight of up to 124,000 lbs., the C-130A can make close turns.

A 5,000-gallon F-6 airport fuelling truck is loaded into the cargo compartment under its own power.



The C-130A's forward loading ramp measures 6 ft. by 7.3 ft.; to its left the crew door with built-in steps.

Carrying 92 combat-ready troops, the C-130 can land near the front, if necessary on grass strips.

Wilson's Edict

Clarifying service rôles

Even before the Congress debates on the U.S. defence budget have really got into their stride there are dull rumblings to be heard in the Pentagon, Congress itself and the press. The U.S. Army feels that it has been slighted by Secretary of Defense Charles E. Wilson's recent decision giving the Air Force the green light to go ahead with the development of intercontinental and intermediate range missiles and also awarding it other equipment to which the Army feels it has a claim. Reports from Washington describe the Army as being so aggrieved that it is only waiting for the Defense Secretary's resignation — which certain quarters forecast for the end of the budget debates — in order to undertake a massive attempt to restore the old situation. Whether the Army will really keep quiet for so long appears somewhat doubtful, judging by the spirited curtain-raiser to the new session of Congress.

What is more, there are no great signs of rejoicing in the Air Force camp either. Stuart Symington, a former Secretary of the Air Force and now a Democratic Senator — who has always thrown himself into the fray like a fox terrier, as soon as he believes the Air Force's interests to be in danger — has mobilized the very influential Air Force Association. What vexes him is that Defense Secretary Wilson plans to cut the Air Force's 137-wing programme by ten wings, as the planned expansion of the Army's anti-aircraft and tactical rocket batteries enables the number of fighter units to be reduced. The Air Force's supporters will fight tooth and nail, announces Symington, if anyone dares to weaken it.

On the surface the conflict centers around the appropriations for the 1957-58 fiscal year, and it is a well-known fact that, when it comes to money, "business is business". The three armed services have asked for a total of roughly $46,000,000,000—Army $11,000,000,000, Navy $12,000,000,000, Air Force $23,000,000,000—a sum which is not only looked upon askance by Secretary of the Treasury George M. Humphrey, but is also considered by the Defense Secretary to be beyond the normal.

Basically, however, money for once plays only a secondary part. The real crux of the matter is the question of who is to have control of modern weapons, particularly guided missiles.

Charles E. Wilson, United States Secretary of Defense.

*

The conflict over guided missiles began at a very early stage, when these weapons were at the very beginning of their development. Even today the number of *operational* guided missiles is still modest. The only examples of the vital surface-to-surface category so far in service are the short-to-medium-range *Matador* (U.S. Air Force) and *Regulus* (U.S. Navy), and the short-range *Honest John, Corporal* and *Redstone I* (all U.S. Army). Long-range missiles such as the SM-62 *Snark* and SM-64 *Navaho* (Air Force) are still in the development stage; admittedly they have already flown . . . but at times with "unknown destination". And the long and medium range ballistic missiles, namely the *Atlas* and *Titan* I.C.B.M.s (Air Force), and *Thor* (Air Force) and *Jupiter* (Army/Navy) are very far from being operational. As regards *surface-to-air missiles* the three services are running practically neck and neck, though the Army (with the *Nike*) and the Navy (with *Talos*) have a slight lead over the Air Force *(Bomarc)*.

However that may be, Army, Navy and Air Force have for many years been bitter rivals in the guided missile development field. And when the first models began testing, all three services so to speak crowded round the gates of the test centres, each hoping to acquire as many as possible for itself to ensure itself an honourable place in the new concept of global strategy. In this initial run the Army, which had long had attractive visions of a 1,000-mile range artillery, kept well out in the lead.

Guided missiles, however, were not the only bone of contention. Who was to be authorized to operate the various categories of aircraft? Who was to be responsible for local and regional anti-aircraft defence, the air umbrella for the troops in battle, ground support and interdiction of enemy supplies, long-range and assault transport? In all the deliberations of the Joint Chiefs of Staff no clear answer, satisfying all parties, could be found to any of these questions.

*

On November 26th, 1956, Defense Secretary Wilson finally severed the Gordian knot. In an eight-page memorandum he allotted to each service its missions and the weapons needed to carry them out.

As the botanist Linnaeus once remarked, every species of plant has a natural urge to overrun the whole garden; it is the gardener's job to keep each within bounds. Wilson has now performed the gardener's task, setting limits in particular to the U.S. Army's ambitions. The main points of his decision allocating defence tasks are as follows.

The technical preparation of *strategic air warfare,* as far as attacks (on enemy centres) are concerned, is confided solely to the Air Force, while defence of the North American continent is the responsibility of all three services.

As regards *tactical air warfare,* the Air Force is responsible for the air support of land operations, e.g., for attacks on enemy bases and strong points etc. Naval air operations (anti-submarine missions, air raids on naval units, naval bases, etc.) are the affair of the Navy.

When it comes to auxiliary missions, Air Force, Navy (Marine Corps) and Army share responsibility for support of ground and sea fighting, fighter cover is to be provided by the Air Force or the Navy, while the Army merely supplies anti-aircraft artillery defence. The Army is also excluded from strategic and tactical air transport.

Such is the broad division of responsibilities for technical development in peacetime. Details are given in the accompanying tables.

STRATEGIC AIR WARFARE

1. Offensive

Technical and organizational preparation on the one hand, and operational control of offensive strategic air warfare—i.e., intercontinental air and rocket attacks on enemy centres—on the other are the *exclusive province of the U.S. Air Force*, above all *Strategic Air Command*.

1.1 Long-range reconnaissance aircraft with intercontinental radius of action (with in-flight refuelling) are procured and operated by the **Air Force.**

An S.A.C. Boeing RB-47E six-jet photographic reconnaissance aircraft.

1.2 Long-range bombers, eight-jet Boeing B-52s and six-jet Boeing B-47s, form the backbone of the **Air Force's** Strategic Air Command.

A Boeing B-52 Stratofortress being refuelled in flight by the first Boeing KC-135 jet-powered strategic tanker.

1.3 Strategic tankers to extend the range of long-range bombers, reconnaissance aircraft and escort fighters are also the responsibility of the **Air Force** (S. A. C.).

A Boeing KC-97A strategic tanker/transport refuelling a Boeing B-47B Stratojet.

1.4 Long-range escort fighters for the active protection of reconnaissance aircraft and strategic bombers: **Air Force.**

In-flight refuelling of an S.A.C. McDonnell F-101A Voodoo long-range fighter by a Boeing KC-97 strategic tanker/transport.

1.5 Intercontinental missiles (pilotless, with wings and air-breathing engines) such as the Northrop SM-62 *Snark* and North American SM-64 *Navaho* continue to come under the **Air Force.**

Launching a Northrop SM-62 Snark (with Allison J-71 and JATO rockets) at an Air Force proving ground.

1.6 Intercontinental ballistic missiles (pilotless, with or without wings, multi-stage rocket), such as the *Atlas* and *Titan* now under development, are procured and operated by the **Air Force.**

Launching a two-stage experimental ballistic missile for measurements in the hypersonic range, at Alamogordo (Aerophysics Development Corporation's Hypersonic Test Vehicle).

2. Defensive

On the other hand, the defensive side of strategic air warfare, i. e., the air defence of the Continental United States, is a *joint responsibility of all three services*, Air Force, Navy and Army. All have their part to play in technical preparations and have delegated units to the peacetime *Continental Air Defense Command*.

2.1 Radar early warning by land stations is the province of the **Air Force,** at sea (by ships or aircraft) of the **Navy.**

U.S. Navy Lockheed WV-2 radar early warning aircraft over U.S.S. Harvesan (DER-316) radar picket ship (and escort destroyer).

2.2 Operational control of integrated air defence (combat operation) is in the hands of **CONAD,** at whose disposition each service places its communications system (the Air Force the Semi-Automatic Ground Environment System—SAGE—for example).

Air Force Aircraft Control and Warning Squadron.

2.3 Land-based all-weather fighters for regional defence are procured and operated by the **Air Force; carrier-based all-weather fighters** are procured and operated by the **Navy.**

Air Force Convair F-102A all-weather fighter.

2.4 Land-based pilotless fighters (armed with air-to-air rockets) for regional air defence are also an **Air Force** affair; **carrier-based pilotless fighters** might later come under the **Navy.**

Drawing of the Boeing IM-99 Bomarc pilotless interceptor under development for the Air Force.

2.5 Guided aircraft rockets or air-to-air missiles are procured independently by the **Air Force** and the **Navy,** each for its own fighters.

Hughes GAR-98 Falcon guided aircraft rocket (Air Force).

Philco AAM-N7 Sidewinder air-to-air missile (Navy).

2.6 Point defence in the Continental United States, by means of anti-aircraft artillery and rockets, is exclusively the responsibility of the **Army.**

U.S. Army battery of Nike Ajax anti-aircraft rockets at Lorton, Virginia.

TACTICAL AIR WARFARE

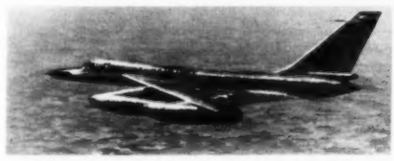
3. Air support of ground operations

Technical preparation and operational control of tactical air raids on land targets, such as strong points, air bases, means of transport, bridges, etc., are *primarily the responsibility of the Air Force*. (The Navy's air units may assist in wartime.) This does not mean, however, that supreme command over Air Force units in wartime cannot be entrusted to an Army general (as theatre commander).

3.1 **Land-based reconnaissance aircraft** are procured and controlled by the **Air Force.**

Air Force McDonnell RF-101A Voodoo, an armed reconnaissance aircraft of long range.

3.2 **Land-based tactical bombers** come under the **Air Force.**



Air Force Convair B-58 Hustler four-jet supersonic bomber.

3.3 **Land-based escort fighters and fighter-bombers: Air Force.**

North American F-100C Super Sabre fighter bomber with 500, 1,000 and 2,000-lb. H.E. bombs.

3.4 **Tankers** to increase the range of all these three aircraft categories: **Air Force.**

A Boeing KB-50 tanker refuelling three North American F-100 fighter-bombers.

3.5 **Land-based medium-range missiles** (air-breathing engines) with ranges of above 200 miles, for example the TM-61 *Matador* tactical missile, are procured and controlled by the **Air Force.**

TM-61B, latest version of the Martin Matador medium-range missile (with modified guidance system) on its mobile launching ramp.

3.6 **Land-based intermediate range ballistic missiles** (rocket powered) with ranges above 200 miles, for example the *Thor* intermediate range ballistic missile: **Air Force.**

4. Air support of naval operations

Technical preparation and control of air raids on naval targets—in particular anti-submarine operations—and the bombing of enemy naval bases and coastal defences are *primarily the responsibility of the Navy*. (The Air Force may provide assistance in wartime.) In armed conflicts requiring extensive fleet operations an admiral will normally be commander-in-chief. Otherwise naval units will be placed under an Army or Air Force general.

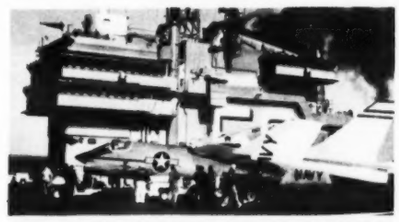
4.1 **Long-range naval reconnaissance aircraft** (land-based) and **carrier-based armed reconnaissance aircraft** fall within the competency of the **Navy.**

Lockheed P2V-7 Neptune land-based long-range naval patrol and anti-submarine aircraft with two auxiliary jets.

4.2 **Carrier-based tactical bombers,** regardless of size and range, come under the **Navy.**

A Douglas A3D-1 Skywarrior carrier-based bomber taking off with the aid of a steam catapult at the Navy's Patuxent River, Maryland, test base.

4.3 **Carrier-based escort fighters and fighter-bombers: Navy.**



Chance Vought F8U-1 Crusader supersonic fighter (with folded wings) aboard the aircraft carrier U.S.S. Forrestal.

4.4 **Tankers** to increase the range of all these aircraft categories: **Navy.**

Four Grumman F9F-8 Cougar carrier-based fighters being refuelled in flight by a Convair R3Y-2 Tradewind flying boat tanker.

4.5 **Ship-based missiles,** regardless of size and range: **Navy.**

Drawing of the Chance Vought Regulus 2 supersonic missile now under test; it can be launched from submarines.

4.6 **Ship-based ballistic missiles,** regardless of size and range, such as the Army-developed *Jupiter C* I.R.B.M. (range 1,500 miles): **Navy.**

AUXILIARY MISSIONS

5. Support of ground and sea fighting

Technical preparation and execution of air missions in direct support of the fighting units in the combat zone are shared by all three services: the *Air Force* supplies the aircraft for the air umbrella and support of the Army's land operations. The Navy's air units perform the same missions for the Marine Corps. *Army* and *Navy* provide independent anti-aircraft defence for their own units and installations; Army anti-aircraft batteries also protect Air Force airfields.

5.1 **Land-based fighters** to protect the fighting units are an **Air Force** concern; **carrier-based fighters** belong to the **Navy**.

Air Force Lockheed F-104 Starfighter supersonic fighter with auxiliary tanks for increased range. The F-104 is also used for home defence.

5.2 **Land-based low-level attack aircraft** come within the Air Force's competency; **carrier-based low-level strike aircraft** come under the **Navy**.

Navy Douglas A4D-1 Skyhawk multi-purpose low-level strike aircraft.

5.3 **Local anti-aircraft defence** by means of artillery or rockets is provided by **Army** and **Navy**. Anti-aircraft rockets (surface-to-surface missiles) already in service are the *Nike Ajax, Nike Hercules, Talos* and *Terrier*.

The converted battleship U.S.S. Mississippi fires Convair SAM-N7 Terrier rockets.

5.4 **Short-range guided and ballistic missiles** (surface-to-surface missiles), with ranges up to 200 miles come under the **Army** and the **Navy's** Marine Corps.

U.S. Army's Dart anti-tank missile, wire-controlled.

5.5 **Light aircraft and helicopters** for combat reconnaissance, artillery observation and assault missions may be procured and operated by both **Army and Marine Corps**; weight limits for the Army 5,000 lbs. (aircraft) and 20,000 lbs. (helicopters).

The Cessna Bird Dog combat zone reconnaissance aircraft is in service with the Marines (designation OE-1) and the Army (designation L-19A).

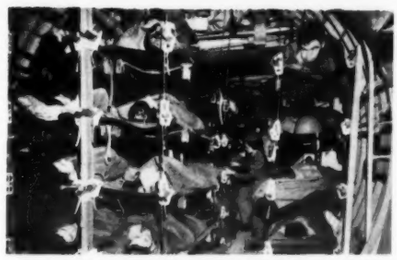
6. Air Transport

Strategic transport, i. e. movement of troops and supplies on a global scale, is *in principle the responsibility of the Air Force* (the Navy has its own long-range transports for troops and priority cargo, e. g., spares). *Tactical transport* in areas near the front comes under the *Air Force* (for Army units) and the *Navy* (for the Marines). *Communications and rescue aircraft* are procured and operated by *all three services*, though with certain weight limitations for the Army.

6.1 **Strategic transports** (and tanker/transports which can be used without conversion to carry troops or supplies): **Air Force**.

Douglas C-133A transport for a payload of more than 110,000 lbs.

6.2 **Tactical transports** (assault transports) for paratroop and/or airborne operations in which enemy countermeasures are to be expected; **Air Force** (for Army) and **Navy** (for Marines).



The U.S.A.F.'s Lockheed C-130A Hercules tactical transport can carry up to 74 wounded on its return flight from the combat zone.

6.3 **Communications and rescue aircraft** for use in the combat zone are procured and operated by **each of the three services.** The Army's aircraft, however, may not exceed an empty weight of 5,000 lbs.

U.S. Army's Beech L-23A communications aircraft (two 260 h.p. Lycoming engines; weight empty 3,950 lbs.).

6.4 **Communications and rescue helicopters** (and assault transports) are procured and operated by **each of the three services.** The Army's helicopters may not, however, exceed an empty weight of 20,000 lbs.

In-flight refuelling of a U.S. Army Vertol H-21C helicopter (for 20 troops or 12 stretcher cases) by a small de Havilland Canada U-1A Otter. The H-21 is also in service with the Air Force.

U.S. Army Sikorsky H-34 helicopter (for 12 to 14 troops; civil designation S-58). The same helicopter is also in service with the Navy (as the HSS-1) and the Marine Corps (as the HUS-1).

The Defense Secretary introduces his memorandum with a reference to the 1947 *National Security Act,* which recognized the three defence services as independent organizations and placed them under the Defense Secretary for control and coordination purposes. Wilson also mentions the additional agreements worked out by the Joint Chiefs of Staff at Key West and Newport and approved by the then Secretary of Defense, James Vincent Forrestal, as well as the 1953 amendments.

Here Wilson recalls the dramatic events of 1949, which have gone down in the history of the U.S. services as the "revolt of the Admirals". At that time the controversy was "strategic bomber force versus aircraft carriers". Air Force and Navy were unable to agree on a division of roles and missions in air warfare. After prolonged congressional hearings, work on the 60,000-ton super carrier was suspended, and the whole "intercontinental strategy" was entrusted to the Air Force and its Convair B-36 long-range bombers. The Air Force had won. Admiral Denfeld, Chief of Naval Operations, left the service, and a few months later the new Defense Secretary, Louis A. Johnson resigned.

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The memorandum of November 26th, 1956, was thus an attempt to forestall any "Generals' revolt" by the Army. It should, however, be stressed that the assignment of roles and missions is intended merely as a guide for peacetime. In wartime theatre commanders (overseas) and the Joint Chiefs of Staff (for the defence of the Continental United States) would be free to form inter-service theatre commands and allocate operational missions.

Wilson's edict is clear and unmistakable. In theory there should be no "revolt of the Generals". However, as a people the Americans are given to controversy . . . even in their Congressional debates and official dealings. "U.S. News and World Report" of December 7th, 1956 provides the Army generals with arguments for a later offensive. "Questions already are being raised over the regulations as finally established. Why give the Army its own close-support missiles, yet retain Air Force control over close-support aircraft with the same mission? Why let the Army run its own helicopter airlifts in the combat zone, yet keep planes needed to carry paratroopers under Air Force control? Why let the Navy develop medium-range missiles as super-artillery, yet prohibit the Army from doing the same thing?"

Will there be a revolt of the generals? The answer to this question may be easier to give in a few weeks' time, when Congress has really got into its stride.

Open Ejection Seat at Supersonic Speeds

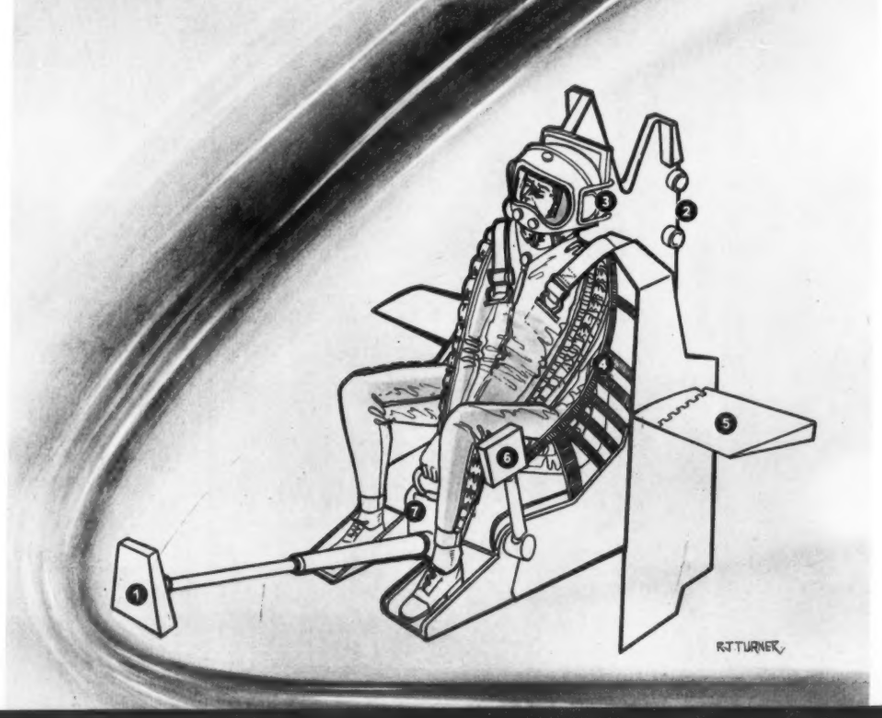
THE LOCKHEED MODEL D EJECTION SEAT

By R. J. Turner, New York, U.S.A.

One year ago when George Smith, a North American test pilot egressed from a distressed *Super Sabre,* the upper limits of safety had been reached for the "open" seat type of ejection at high speed. The next step, thought the experts, was the capsule, which would take the form of the aircraft's nose, part of the nose, or an internally stowed cocoon, all of which imposed ill afforded weight penalties. Whatever the answer was to be, an immediate problem became evident, the equipping of a safe egression device on a brand new series of high performance aircraft soon to be in service in quantity; most notable of these were the F-100, F-101, F-102, F8U and F-104, all of them capable of speeds in excess of Mach 1.

To consider the capsule application to a small light weight vehicle such as the F-104 would have ruined its present remarkable performance. With this grave possibility as the incentive, engineers of the Lockheed Corp. had a creative touch of genius whose results

Lockheed Model D supersonic ejection seat: 1 – retractable skip cone generator; 2 – skid block and rollers for ejection; 3 – helmet position members; 4 – restraining webbing; 5 – stabilizing fins; 6 – knee restraints; 7 – handhold.



surprised engineers in many parts of the country—the model D seat described in this article.

At first glance the new seat does not appear to offer much protection to the occupant against winds in the order of 1,500 miles an hour, but an appendage in the form of a pole sticking forward into the airstream takes advantage of an aerodynamic phenomenon called the Mach cone. Aircraft designers have been taking advantage of this characteristic of air flow for some time in the design of high speed intakes for jet aircraft. In general a protuberance ahead of a body travelling at supersonic speeds sets up a cone shaped region of low speed air; the occupant of the new ejector seat will sit inside this region in comparative safety from the buffeting of high air loads.

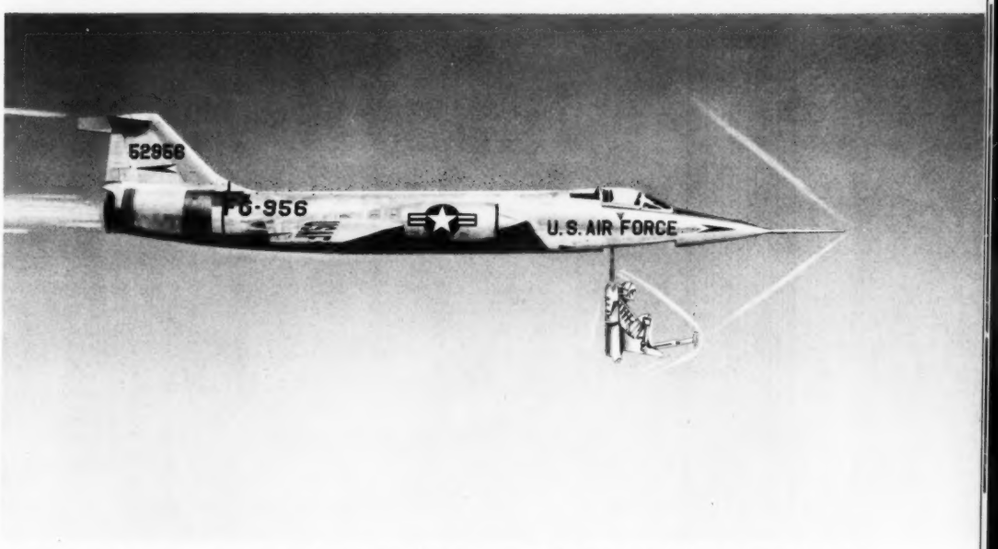
Wind tunnel tests indicate pressures on the occupant's body, particularly his chest, have been reduced to 25% of those experienced on standard type ejector seats.

One of the almost insurmountable problems associated with throwing an object out into a fast moving air stream is the decelerating force due to the drag of the body. Here again the Mach cone generator has come to the aid of the design; the drag of the body has been reduced considerably, thereby cutting down the decelerating G's to within the tolerances of the human occupant.

Stability of the seat, that is its ability to remain in a state where excessive rolling, yawing or pitching cannot injure the occupant, has in the past been partly corrected by devices such as the drogue chute. This method has now been abandoned in favor of a lead weight placed at the extreme end of the Mach cone generator. This serves to move the center of gravity of the configuration well forward.

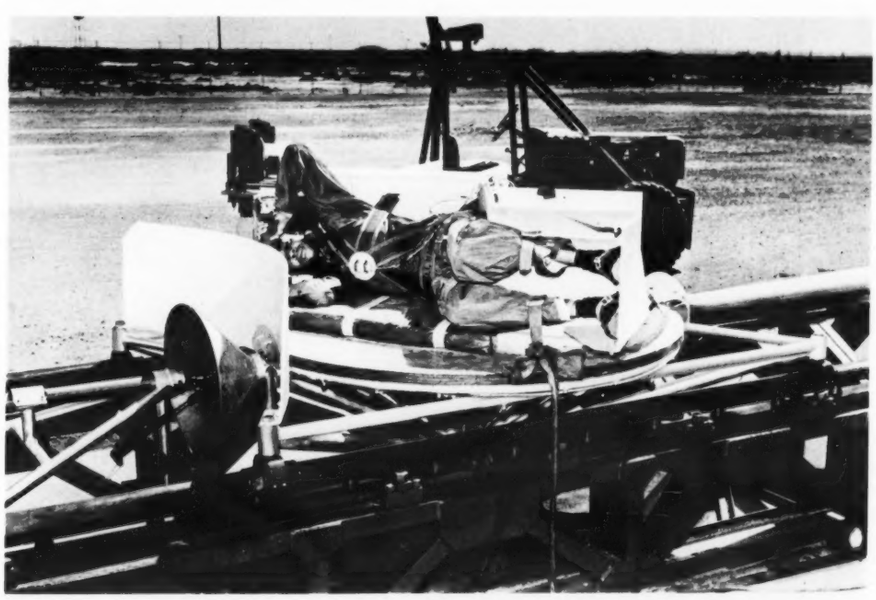
The seat will be used for downward ejection on the F-104 aircraft, necessitating rolling the ship on its back for a zero altitude escape. With aircraft favoring an upward ejection, modifications to the cockpit and windshield position could easily be affected.

Interesting design features of the Model D Supersonic Seat are two stabilizing fins with wedge profile (on both sides of the seat) and a headrest with side frames to hold the pilot's head in the correct position. (Schlieren photographs indicate shock waves emanating from his helmet.) Furthermore, there are knee plates to prevent legs from spreading, and a hand grip prevents arms from flaying. Webbing is used to retain the body centrally on the seat, and there is automatic retraction of the feet from the rudder pedals to the seat footrests.



After ejection of the seat, the projecting bar forms a Mach cone around the pilot, who is thus protected from the injury which would otherwise be caused by the undiminished dynamic pressure of the air flow. (In this drawing the escape equipment is shown slightly too large in relation to the aircraft.)

Sled at the U.S. Air Force's Holloman Air Development Center, New Mexico, used to determine the physiological and psychological effects of abrupt decelerations, with the body in various positions. Guinea pigs in these tests are medical and other officers from the Center. Here Lieutenant Wilbur C. Blount races down the track. Abrupt deceleration is produced by the piston on the front of the sled entering the water-filled cylinder at the end of the track (far right).



The Surface-to-Surface Missile, Today and Yesterday (III)

By Frederick I. Ordway, III, Executive Vice-President,
General Astronautics Corp., Oyster Bay, New York

One of Aerojet-General's test beds for liquid-propellant rockets.

The first and second parts of the article (*Interavia* No. 12, 1956 and No. 1, 1957) described the historical development of rocket weapons up to World War II and the present position in surface-to-surface missiles (in particular the I.C.B.M. and I.R.B.M.). The third (and last) part discusses primarily the jet-powered guided bomber and the use of medium-range rockets aboard cruisers and submarines. A survey of U. S. appropriations for guided missile development in recent years and an estimate of the prospects for peaceful applications of the new branch of engineering bring the series to a close. Editors.

The U.S. Army's short-range missiles

As indicated last month, U.S. Defense Secretary Charles E. Wilson laid down in his decision of November 26th, 1956 that the *Army's* surface-to-surface missiles should be limited to a range of 200 miles and be fired against targets not more than 100 miles beyond the front line.

The missiles falling into this category—all are rocket-powered—are listed in *Table 5*. They are (1) the partially guided (i.e., during the launching phase, up to burnout command) *Corporal,* (2) the wire-controlled *Dart* anti-tank missile, (3) the unguided *Honest John* and *Little John* and (4) the inertial-guided *Jupiter A* and a number of new developments. (Pictures of most of these weapons were reproduced in the January issue.)

The missile is admittedly a one shot affair, and off-hand would seem to be prohibitively expensive, especially in terms of the limited payload. We must not forget, however, the tremendous destructive capability of atomic warheads. The missile has already proved its usefulness as an infantry assault weapon, and we should find them gradually replacing artillery. They have a great tactical potential in the field, especially as accuracy improves. Even the unguided field artillery rocket *Honest John* recently hit within some 40 yards of a target center from a distance of just under 11,000 yards.

The missile's field advantages include its massed firepower potential coupled with manoeuvrability due to light-weight launchers. A missile like the *Corporal,* reaching 50 to 70 miles behind enemy lines, could disrupt troop movements, blast fortifications, destroy bridges and disrupt communications centers far out of reach of conventional cannon. Then, too, the smaller field missiles and launchers could operate from areas where artillery could never go, such as in mountainous or jungle areas.

Jet-powered guided bombers

Table 6 lists the known U.S.A.F. and U.S. Navy jet-powered guided bombers, parallel

TABLE 5 **U.S. Army surface-to-surface missiles**

Contractor & Designation	Power Plant & Maker	Thrust lbs.	Guidance	Length ft.	Diameter ins.	Weight lbs.	Propellants	Range miles	Remarks
Firestone Tire & Rubber *Corporal* SSM-A-17 (XM4E1)	Aerojet & Ryan liquid rocket	20,000	Gilfillan & Motorola beam guidance	45—46	30	12,000	Monoethyl-aniline & nitric acid	50—75	In production, service. More than 200 fired at White Sands. Atomic capability. Warheads can be changed according to need. Six new battalions equipped with Corporals just announced.
Aerophysics Development *Dart* SSM-A-23	Grand Central solid rocket	—	Wire-controlled	6	(10)	(300)	Solid	(3)	For ground combat operations, anti-tank, artillery type. Developed by Aerophysics Development, production planned by Utica-Bend Corp.
Douglas-Emerson *Honest John*	Hercules Powder solid rocket	—	Unguided	app. 27	30	6,000	Solid	15—25	Artillery missile, in service in U.S. and with U.S. Forces in Japan and Germany. Artillery-like fire control system.
Douglas-Emerson *Little John*	Hercules Powder solid rocket	—	Unguided	(12)	(app. 12.5)	(1,000)	Solid	(10)	Short-range version of Honest John, with atomic capability. Will be used as divisional artillery.
Lazy Dog	—	—	—	—	—	—	Solid	—	Anti-personnel.
MX-773	—	—	—	—	—	—	—	—	Long-range, in project stage.
Sergeant	Solid rocket	—	—	—	—	—	Solid	(50)	Under development.
Cornell-Martin *Lacrosse*	Solid rocket	—	No observation during flight required	(9)	—	(500)	Solid	8—10	Close support; developed by Cornell Aeronautical Laboratory; built by Glenn L. Martin.
Chrysler *Jupiter A* (ex-Redstone)	North American liquid rocket	75,000	Inertial	70	65	(40,000)	Liquid	200—300	About one a month being made at Chrysler; first 20 to 30 built at Redstone. In use with 217th Field Artillery Battalion. Atomic capability. All equipment readily transportable by air.

Figures in brackets are estimates.

TABLE 6

U.S.A.F. and U.S. Navy Air-Breathing S.S.M.s

Contractor & Designation	Power Plant & Manufacturer	Thrust lbs.	Guidance	Length ft.	Diameter ins.	Weight lbs.	Range miles	Speed Mach No.	Remarks
Martin *Matador* TM-61A TM-61B	Allison J-33-A-37	7,000	Radio control	39.5	54	12,000	A: 600—620 B: 650	0.9	Manufactured in 7 major parts. Guidance, not fuel capacity, sets range limits. Various warheads. Zero-length launcher uses T-50 solid booster. Storable for long period. TM-61B costs about $ 85,000.
North American *Navaho* SM-64 (now SM-104A)	2 × Wright ramjet plus NAA liquid-fuel booster of approx. 100,000 lbs.	(2× 30,000)	Celestial	—	—	—	4,000—5,000	3 (2.5—4.0)	X-10 used for flight testing. Various versions in development. During summer 1956 additional $ 5,000,000 earmarked for Navaho.
Chance Vought *Regulus I & II* (SSM-N-8)	Allison J-33-A-18A	5,000+	Command	33	54	14,500	200—300 (perhaps up to 500)	0.9—1	Boosted by two Aerojet solid rockets. Sperry autopilot for attitude control. Model II in production under a $12 million contract. Launched from submarines, surface ships or shore bases. Version with landing gear can be reused after landing.
Northrop *Snark* SM-62	Pratt & Whitney J-57 plus 2 boosters	12,000+ plus 2 × 33,000	Inertial with star tracker	74	54	35,000	4,000—5,000	0.9—1.5	Tailless configuration, to date has flown 2,000 miles. Now in production. Future production 50 per month. Can be carried in C-124 transport aircraft.

Figures in brackets are estimates.

developments to the rocket-powered I.C.B.M. and I.R.B.M. (and a number of short-range ballistic missiles). Powered by turbojets or ramjets, they are designed for a wide variety of ranges, from short *(Regulus)* to extra long ranges around 5,000 miles *(Navaho* and *Snark)*.

These missiles are guided by radio navigation or radio command equipment (on shorter ranges) or by automatic systems of celestial navigation (on longer ranges), in some cases in conjunction with the accelerometers and integrators of an airborne inertial navigation system.

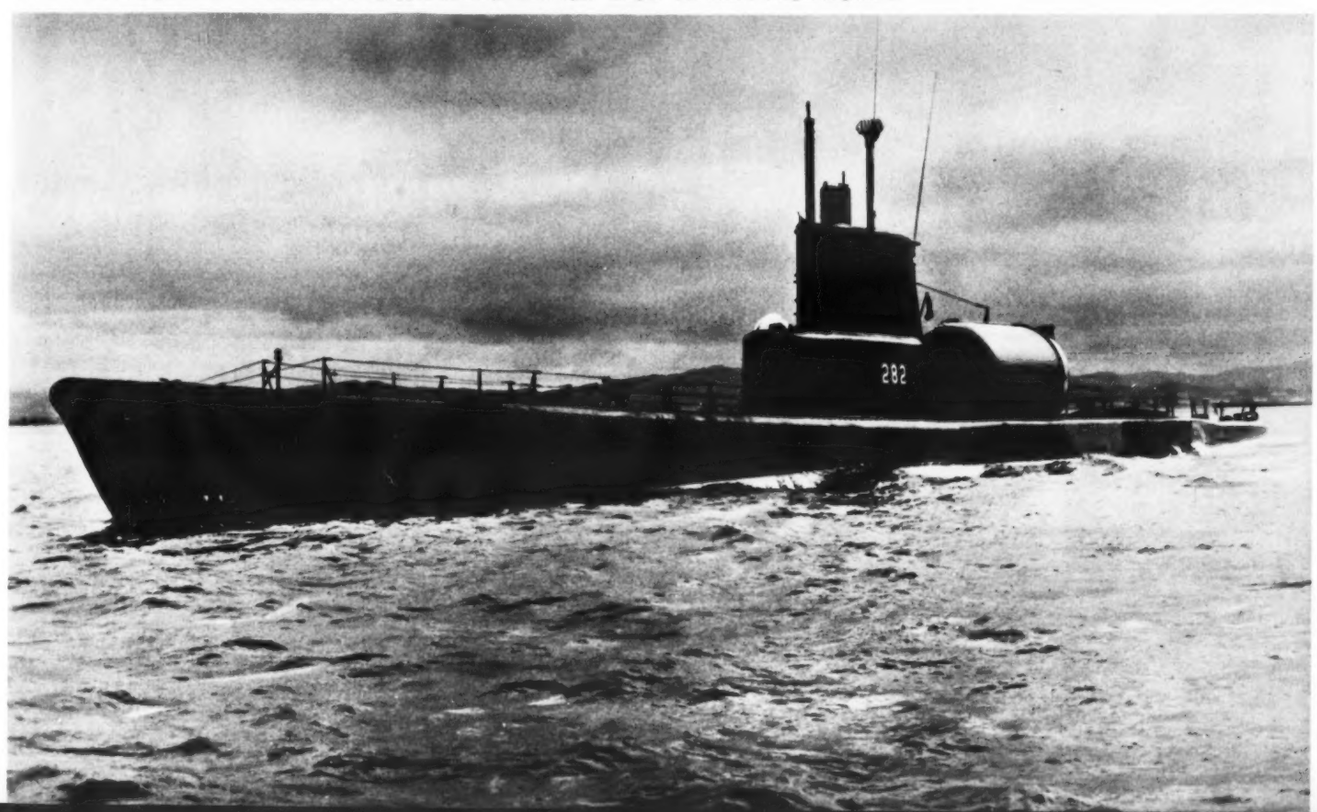
Missiles and the Navy

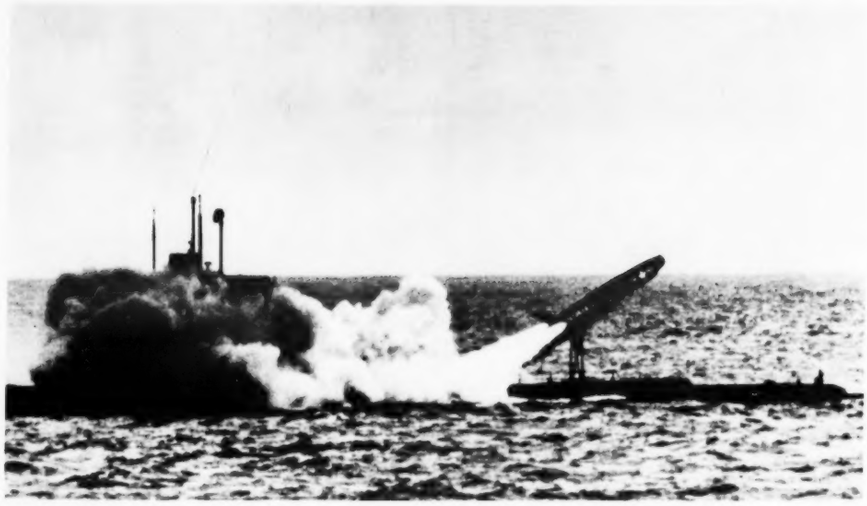
During the years we shall probably see the gradual replacement of large naval rifles by a variety of guided missiles, one of the key types of which will undoubtedly be the surface-to-surface variety. Once the Navy reaches the stage when her ships can handle the I.R.B.M., few places on the globe will be free from the danger of bombardment. Here we must remember that the U.S. Navy has as one of its roles an auxiliary aid to strategic air offensive.

Today, the Navy is cooperating closely with the Army in the development of *Jupiter C,* a 1,500 mile range ballistic missile. This missile, when ready for shipboard use, will pose a number of problems, not the least of which is storage. Concurrent with its development must come the perfection of a stabilized platform from which the missile can be launched independent of the attitude of the ship. As this and smaller missiles go into service, a whole new art of naval warfare will open up. Crews will have to be taught missile handling and launching techniques, methods will have to be developed to reduce the danger of propellant transfer during rough weather, booster elements will have to be carefully monitored lest they fall on other ships, and new design features will have to be incorporated. The Navy may use the hull of the uncompleted battleship *Kentucky* as the basis for its first ballistic launching ship.

Furthermore, it was recently announced that the "rocket ship" U.S.S. *Carronade* houses a huge electromechanical Mark 91—Mark 92 double computer for use against shore based targets, particularly troop concentrations. The computer is supposed to handle the ballistic

The U.S.S. *Tunny* guided missile submarine is equipped with a pressure-tight "hangar" for Chance Vought *Regulus I*.





A *Regulus I* being fired from the stern of the U.S.S. *Tunny* in the central Pacific. The submarine has become an aircraft carrier.

calculations for as many as four types of rockets and firing conditions.

*

And the submarine?

In February 1956 the Navy disclosed that it would build a nuclear powered submarine with guided missile armaments (S.S.G.N.). Already, the conventional submarines, *Barbero* (S.S.G.-317) and *Tunny*, are fitted to launch missiles at sea, and the *Grayback* (S.S.-574) and *Growler* (S.S.-577) are being launched soon as guided missile subs.

Increased awareness of the submarine-missile threat has become apparent all over the world. In September 1956 *Garrison Norton* (Assistant Secretary of the Navy for Air) estimated that Russia had more than 400 submarines, many of which are missile-equipped. And Vice Admiral T.S. Combs (Deputy Chief of Naval Operations for Air) pointed out that "with the advent of the guided missile, our country and our allies are threatened by direct attack from submarines."

*

As there are arguments between the Army and the Air Force, so there are between these services and the Navy. One of the more interesting phases of missile debates involves the relative strategic value of the ship-launched I.R.B.M. and the land-launched I.C.B.M. There are cases for both, but the main arguments run somewhat as follows:

The more recent *Regulus II* for supersonic speeds is now being tested by the U.S. Navy. It is also to be launched from submarines.

1. The I.R.B.M. is simpler to make, and less costly, since it must travel only some 1,500 miles. The development of the I.C.B.M. is of staggering proportions, and is still years away. A successful I.R.B.M. will probably be ready within two to three years, or perhaps sooner.

2. A 1,500 mile flight is more apt to be successful than a flight of 3,000 miles or more. Accuracy will be far superior in the case of the I.R.B.M.

3. Based on today's missile know-how, the I.R.B.M. can probably do more damage per dollar spent, and will undoubtedly be more reliable.

4. A Navy I.R.B.M. would be launched from a continually moving base. A land base might well be known to an enemy, and destroyed.

On the other hand, missile ships would always be vulnerable to enemy bombardment, both with conventional torpedoes, gunfire, and bombs, and with air-to-surface and surface-to-surface missiles. All arguments will be subject to revision as both the I.R.B.M. and the I.C.B.M. develop, and as the balance of sea and air power changes from one side to the other. All statements from the services are inevitably charged with political overtones.

In any event, missile-minded naval planners have outlined a program for nearly 50 missile ships within the next five years. *Rear Admiral John E. Clark,* director, Guided Missiles Division, Office of the Chief of Naval Operations, said that the current *Regulus I* is already on 4 carriers, 4 cruisers and 2 submarines. He added that the Navy is currently designing ships to handle and fire *Jupiter C* rockets.

*

In connection with the Navy, we might well mention two underwater varieties of the S.S.M., the *underwater-to-underwater* and the *underwater-to-surface* missiles.

The Germans did some work on both types at Peenemünde and reportedly reached the preliminary test stage. It has been rumoured that Russia has an underwater launching system (effective up to 300 feet below the surface) that can fire missiles against surface targets nearly 150 miles away.

The United States is presumably working on methods of launching both medium and large missiles from submerged submarines for use against surface targets, such as ports and

TABLE 7 **Government money spent on guided missiles**

Fiscal Year	Air Force	Navy	Army	Total
1950/51	15,500,000	5,100,000	400,000	21,000,000
1951/52	66,400,000	56,100,000	46,400,000	168,900,000
1952/53	81,100,000	94,800,000	119,100,000	295,000,000
1953/54	175,900,000	141,100,000	186,600,000	503,600,000
1954/55	305,000,000	176,000,000	238,000,000	719,000,000
1955/56	485,000,000	130,000,000	360,000,000	975,000,000
*1956/57	799,000,000	177,000,000	300,000,000	1,276,000,000

* estimate

coastal industrial complexes. In the news section of the June 1956 "Aero Digest" it was suggested that a tiny electronic positioning scanner might be released by a submarine to float on the surface, and that with this device an underwater-launched S.S.M. could be guided to a distant target. At the same time, the U-boat would have no fear of enemy electronic detection. Hughes Aircraft is reportedly studying underwater-to-surface missiles at the present time.

Straight *underwater-to-underwater rockets* would be sophisticated torpedoes. They could be launched from such post-war hydrodynamic research craft as the radical new submarines *Albacore* (which boasts great speed and manoeuvrability) and the atomic-powered *Nautilus*.

Missile Money

The Armed Forces are spending more and more money on missiles. According to the Aircraft Industries Association, 1956—57 spending should amount to over $1,250,000,000, which would be more than *twice* the money spent by the Army and Navy for *all* military aviation in 1941. *Table 7* shows the increase in the amount of government money spent on guided missiles from 1950 to 1954, together with figures extended to 1957. (Figures released officially do not always tie in with those released by generals and admirals at hearings).

The national guided missile program is sustained by a huge industry in this country. Most large aircraft companies have created guided missile divisions. Dozens of missile development programs sustain companies engaged solely in the design, development and production of rocket engines. Scores of enterprises thrive in the missile avionics (aviation electronics) field. A list of contractors and sub-contractors would run into pages, as the missile program also benefits the propellant industry, both solid and liquid, and indirectly such basis fields as the chemical and metallurgical industries.

The need for detecting possible incoming enemy missiles and the requirement of accurate tracking of our own have fostered a robust radar development program. One of the more elaborate radar installations will consist of 21 units to record flights of missiles from Cocoa, Florida, out over the Atlantic Ocean. It is said that such radar can report to the Flight Control a missile flight within an accuracy of two one-hundredths of a degree.

Table 8 gives an interesting comparison, that of Research and Development monies available to missile and aircraft in the United States for each fiscal year since 1949, with the indicated projection to 1957.

Unofficial estimates claim that $2,500,000,000 are to be spent on missiles in fiscal 1956/57 with Air Force getting $1,000,000,000, and the Army and Navy about evenly splitting the remainder. This would be $1,200,000,000 more than shown on *Table 7,* indicating that many observers are visualizing abrupt new changes for missile expenditures.

TABLE 8 **R & D Funds**

Fiscal Year	Missiles	Aircraft
1949/50	106,900,000	125,500,000
1950/51	185,000,000	209,500,000
1951/52	308,600,000	245,400,000
1952/53	350,400,000	239,900,000
1953/54	220,800,000	237,100,000
1954/55	212,100,000	250,500,000
1955/56	231,300,000	270,300,000
*1956/57	199,000,000	253,700,000

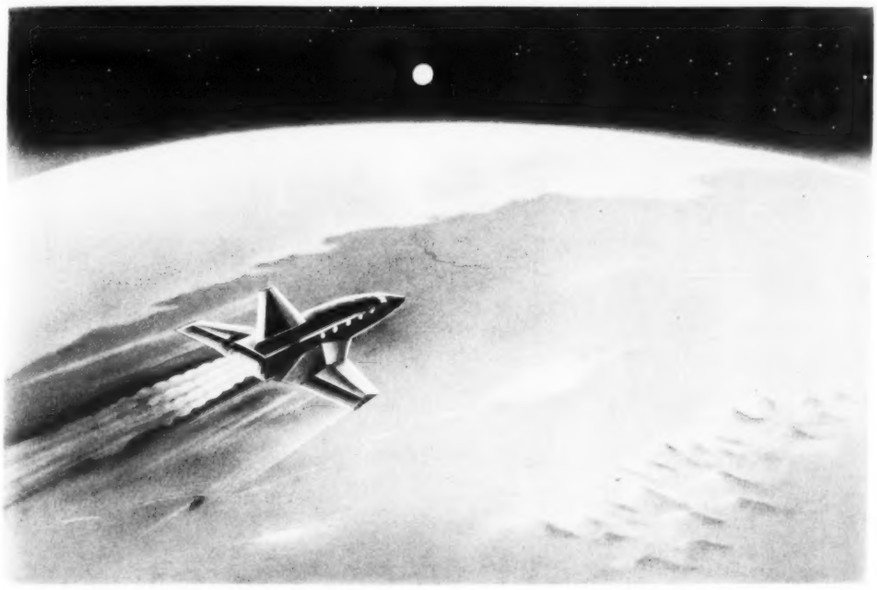
* estimate

S.S.M.'s for Peace

Brief mention should be made of peacetime uses of surface-to-surface missiles. We have, of course, for years heard of *life-saving rockets* and *mail rockets;* the former have saved the lives of many a person stranded in a sinking vessel, but the latter never amounted to much. At a meeting in California late last spring, *Hall L. Hibbard,* Vice President and General Manager of Lockheed's Missile System Division, predicted big things of mail rockets. "Missile mail", he felt, may some day take a "letter across the nation or around the world at tremendous speeds". He added later that "*freight rockets* for premium express" could also evolve logically from today's missile projects.

Whether trans- or inter- continental *passenger rockets* go under the name of missiles or airplanes will probably be decided only when practical designs are worked out. One preliminary idea was presented in *Interavia 5,* 1955, in an interesting article "The Rocket-Driven Commercial Airliner" by Dr. Walter R. Dornberger. His large rocket plane would carry passengers from Sydney, Australia to London in somewhat more than an hour and a half.

Tomorrow: A large passenger rocket climbs at hypersonic speed to an altitude of 27 miles, where it cuts off its motors and continues to its destination in a long hypersonic glide (Dr. W. Dornberger).



What's in the Air?

Extracts from Interavia Air Letter, *daily international news digest, in English, French and German. All rights reserved.*

AIR TRANSPORTATION

● **The world's scheduled airlines** (excluding those of the U.S.S.R. and the Chinese People's Republic) in 1956 carried 78 million passengers, an increase of 15% over 1955 and of nearly 350% over 1946, according to Dr. Edward Warner, President of the Council of the International Civil Aviation Organization. I.C.A.O.'s statisticians expect that the airlines of the world will reach the 100-million-passenger mark for the first time in 1958. Ten years ago the average aeroplane carried 17 passengers at 155 m.p.h.; today it is 28 passengers at 200 m.p.h. A comparison between traffic figures for 1956 and 1955 reveals the following increases (all figures in millions): miles flown 1,630 (1,440) + 13%; passengers 78 (68) + 15%; passenger-miles 45,000 (39,000) + 16%; cargo ton-miles 1,030 (910) + 13%; mail ton-miles 280 (260) + 8%.

Sir William Hildred, Director-General of the International Air Transport Association, also made a year-end survey, making similar predictions to Dr. Warner's. Among other things, he forecast that the number of passengers flying the North Atlantic route alone may reach the 1,000,000 mark in 1957. In his view, however, it would be unrealistic to make these predictions without adding a few words of caution. The economic balance of the air transport industry is still precarious. Furthermore, the many millions invested in the new generation of jet and turboprop aircraft will not pay off in dividends or in terms of cheaper transport for a much greater public unless there is an adequate improvement and expansion of airports and navigation aids. The airlines also view with some anxiety recent efforts by governments to increase the taxes and charges imposed upon them, and they are concerned that the forthcoming Universal Postal Union Congress may decree a cut in the rates paid airlines for carrying mail. It is also disturbing to notice that the upward trend in prices which airlines have been able to withstand over the past decade has become unusually pronounced during the past six months.

● **Twenty Vickers Vanguards** have been ordered by Trans Canada Air Lines as their medium-range replacement. Total value, including spares, $67,000,000. Deliveries are to begin in the early autumn of 1960. The aircraft will be powered by Rolls-Royce *Tyne* "stage two" turboprops of 5,315 e.s.h.p. and will cruise at over 420 m.p.h. at 20,000 ft., carrying 82 first-class or 102 tourist passengers. A mixed layout of 60% tourist and 40% first class is also possible.

Friedrich Wilhelm Seekatz, director of the Heinkel works (left; cf. elsewhere in this article), who celebrated his 70th birthday on December 15th, 1956, and Professor Ernst Heinkel (with stick) at the Paris Air Show.

Colonel Louis Clerc, former Director of the Swiss Federal Air Office, during whose term of office the new Swiss Air Law was prepared, died at Serrières on January 7th, 1957, aged 69.

Major General Porru Locci (Italian Air Force), Director-General of Civil Aviation at the Defence Ministry, has been promoted to Lieutenant General.

● **A second American-flag round-the-world airline route** is in preparation, following President Eisenhower's authorization for Trans World Airlines to extend its international route from the United States beyond India and Ceylon to Bangkok and Manila, where it will link up with Northwest Orient Airlines' services to the West Coast of the United States. The first round-the-world route was awarded to Pan American World Airways in 1947.

● **Air France's passenger volume** in 1956 rose by 24% over the previous year, from 1,837,000 to 2,280,000, according to provisional figures. Freight + 15%, mail + 31%.

● **K.L.M. Royal Dutch Airlines** announces the following increases in traffic figures in 1956, compared with 1955: passengers 820,000 (725,000) + 13.1%; freight + 15.8%; mail + 13.8%.

● **British Overseas Airways Corporation** will introduce the Bristol *Britannia* on the Kangaroo route from Britain to Australia on March 2nd. The aircraft will reduce travelling time between London and Sydney by 28 hours to 47 hours. *Britannias* are to go into service on the London–Johannesburg route on February 1st, and a later version will be introduced for trans-Atlantic crossings next year.

● **London Airport** handled more than 3,000,000 passengers in 1956. Airport officials estimate that 4% of the whole world's air passengers last year used London Airport.

● **A statistical survey** just published by Australia's Department of Civil Aviation shows that Australian National Airways, the private enterprise airline, still heads Trans-Australia Airlines, the Government domestic operator, in total ton mileage performed for the year ended June 30th, 1956, though the *Viscount*-equipped T.A.A. has further advanced its passenger carrying lead over the DC-6B-equipped A.N.A. The survey shows that A.N.A. performed 48,761,000 ton-miles for the year (56.4% passengers and 43.6% freight), compared with T.A.A.'s 47,106,000 ton-miles (76.1% passengers and 23.9% freight). Ansett Airways, third on the list (it operates Convair 340s as tourist-coaches) showed a total ton mileage of 12,159,000 (71.4% passengers and 28.6% freight). For each hour flown A.N.A. recorded 641 ton-miles; T.A.A. 525½ ton-miles, and Ansett 450½ ton-miles. Of the total of 128,440,762 ton-miles accumulated by all Australian domestic carriers these three airlines contributed more than 84% (108,026,000 ton-miles). In the year 2,075,875 passengers were carried (up 5.7%) and 85,813 tons of freight (up 7.4%).

● **The Egyptian authorities** have given permission for British and French air passengers to land at Cairo airport in transit, according to the independent newspaper "Al Ahram". The paper said they

F. von Balluseck, Executive Vice-President–Traffic of K.L.M. Royal Dutch Airlines, who had been with the company since 1934, resigned on December 31st, 1956, but will continue his link with K.L.M. as traffic adviser for another year.

Linee Aeree Italiane has reorganized its Board of Directors. *General Aldo Urbani* (left), former Chief of the Italian Air Staff, has taken over the Presidency of the company from Prince Marcantonio Pacelli; *Dr. Franco Palma* (right), pilot in the Air Force Reserve and hitherto engaged in the chemical industry, has been elected Vice-President, in succession to Richard Mazzarrini, special adviser to the President of Trans World Airlines.

Mundy I. Peale, President of Republic Aviation Corporation, has been elected President of the Institute of the Aeronautical Sciences for 1957.

would be confined to the airport and would not be allowed to contact outside persons.—All British and French travellers had been banned from Egypt since the Anglo-French military intervention.

INDUSTRY

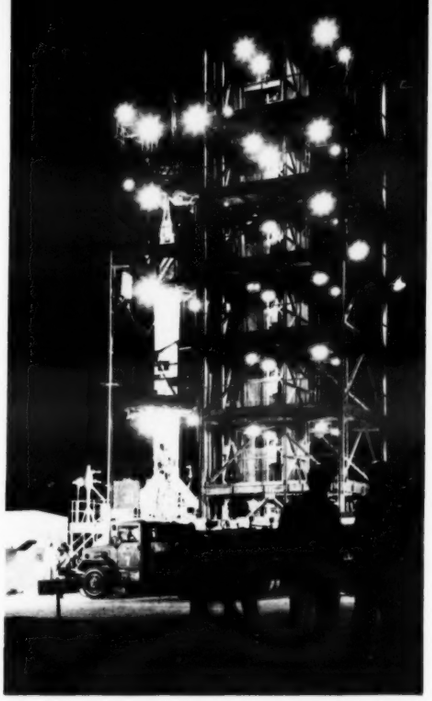
● **The U.S. aircraft industry** increased its sales during 1956 to $8,600,000,000, compared with $8,500,000,000 in 1955, according to the annual report by Admiral DeWitt C. Ramsey, President of the Aircraft Industries Association of America. As in previous years, military sales represented between 85 and 90% of the industry's total output. The number of military aircraft produced amounted to just under 7,000 units, compared with approximately 8,000 in 1955. The fall in deliveries was, however, largely balanced by increases in guided missiles production.—The number of civil aircraft sold during 1956 reached 7,500, or roughly 2,700 more than in 1955. Utility aircraft accounted for the bulk of this increase, with total deliveries reaching roughly 7,100 (4,575 in 1955), with a total value of nearly $100,000,000 ($63,112,000). The number of advanced models of existing piston-engine airliners delivered was approximately 200 (113 in 1955).

With its average labour force of 800,000, the aircraft industry now takes first place among U.S. employers. Total payroll for the year is expected to exceed $4,400,000,000. The aircraft industry is also in a special position as regards the employment of engineering and scientific personnel. Today roughly one out of every ten workers is engaged in engineering activities, compared with one in 25 during World War II.

Total sales for 1957 are again expected to exceed $8,500,000,000, though once more the total number of military aircraft produced will probably decline. Commercial aircraft deliveries will be almost entirely of piston-engine types, though the first turboprop airliner will be delivered in the autumn. The industry's backlog stood at $18,363,000,000 on October 1st, 1956, of which total military orders accounted for $12,822,000,000 ($15,705,000,000 and $11,553,000,000 respectively at the beginning of 1956).

● **North American Aviation** has purchased approximately $32,000,000 worth of titanium during the past five years. The F-100 *Super Sabre* employs about 600 lbs., and its aft fuselage is believed to be nearly 100% titanium. North American reports, however, that the metal's weight-saving advantages are often offset by its formability limits and lack of uniformity, which makes it necessary frequently to design parts as multiple pieces instead of a single piece. This results in a weight increase due to the addition of fasteners, overlapping flanges and splice plates. North American has also found the assembly of titanium details into acceptable airframe sections to be extremely costly and troublesome. Some of the major problems traced to non-uniform material are delayed cracks (that appear after details have been assembled) and cracking during assembly and riveting.

Present day missile designs make possible the use of titanium alloys which have sufficient strength to withstand temperatures resulting from speeds between Mach 3 and Mach 4. The North American *Navaho* missile uses approximately 10,000 lbs. of titanium.



Viking rocket No. 13 was launched from Patrick AFB, Cape Canaveral, Florida, on December 8th, 1956, in preparation for the International Geophysical Year. It reached an altitude of around 125 miles and came down in the Atlantic 175 miles from Patrick.

● **Société d'Etude de la Propulsion par Réaction** states that its new technical installations at Melun-Villaroche will be completed in February. They are among the most up-to-date of their kind in Europe. The funds for the establishment of test benches at S.E.P.R. were voted by the Government in 1953.

● **Friedrich Wilhelm Seekatz** celebrated his 70th birthday on December 15th, 1956. An internationally known aviation pioneer, he began his career at Berlin-Johannesthal, but moved to Holland after World War I, joining Fokker as commercial director. Seekatz is incontestably one of the world's greatest aircraft dealers. Not only all Fokker aircraft and licences went through his hands, but also all Douglas aircraft sold in Europe before World War II—when Fokker was Douglas agent—were sold by him. For the past few years he has been Manager of the Heinkel works.

SERVICE AVIATION

● **The U.S. defence budget** set the stage in Congress for what was expected to be the most lively debate on weapons expenditures in recent budget history. Originally the Army asked for new money totalling about $11,000,000,000, the Navy about $12,000,000,000 and the Air Force about $23,000,000,000, for an overall total of $46,000,000,000. Defense Secretary Charles E. Wilson said this was a "flash" estimate and ordered all-round trimming—by $6,000,000,000. Secretary of the Treasury George Humphrey also looked wryly on these figures, since a balanced budget is part of the Republican Party's credo. The real show-down on defence figures was expected to come when the Air Force request came under scrutiny. Air Force obligations in fiscal 1957 amounted to $16,855,955,000, a figure which Chief of Staff General Nathan Twining said he hoped would be increased next year. But reports indicate that the Air Force will do very well if they get $20,000,000,000.

● **The British-developed steam catapult** for aircraft carrier take-offs is being adopted by the Dutch and French navies, the Admiralty announces. Regarded as one of the most important naval aviation developments since World War II, the catapult is in use on some American as well as British carriers. The Dutch carrier *Karel Doorman*, being modernized at Rotterdam, and the French carrier *Clemenceau*, now under construction, are to get steam catapults. America's new 70,000-ton carrier, the *Forrestal*, has several of the catapults, and the United States Government has acquired the right to manufacture the device.

● **New Chief of the Norwegian Defence Staff** (Commander-in-Chief of the Armed Forces) is Air Force General Bjoerne Oen (58), who succeeds the late Lieutenant General Finn Lambrechts. General Oen fought against the German invasion of Norway and went to Canada in the summer of 1940, where he became head of the Norwegian air units. Later he prepared the establishment of a Norwegian fighter wing in England. From 1942 to 1945 he served at the Norwegian Armed Forces Command, and from 1946 to 1951 was Commander-in-Chief of the Norwegian Air Force. He was then posted to Headquarters, Allied Powers in Europe as Norwegian representative and was appointed to Director of the Norwegian War Academy in February 1954.

● **The U.S. Navy** has awarded New York Shipbuilding Corp., of Camden, New Jersey, a contract for a guided missile cruiser conversion. The contract price is $14,000,000, subject to redetermination at 30% of completion. The cruiser to be converted is the *Little Rock*, launched in 1944. She will be equipped to launch *Talos* surface-to-air missiles.

● **The service pilot shortage** at Hamamatsu base, Japan, is so acute that most of the 90 North American F-86F *Sabre* fighters stationed there are standing idle. Hamamatsu has at present only 20 pilots qualified to fly jets, and base officials fear that the *Sabres* may become useless by the time sufficient pilots have been trained to fly them. The aircraft are wrapped in vinyl cocoons and lined up along the airstrip.

George R. Edwards, Managing Director of Vickers-Armstrongs (Aircraft) Ltd. has been awarded a Knighthood by Queen Elizabeth. Sir George created the turboprop *Viscount*.

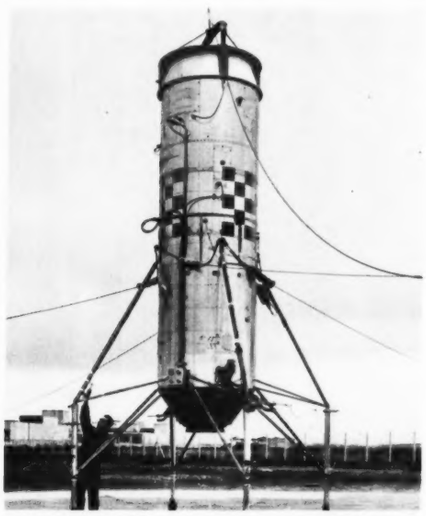
A B-57 bomber, converted by Temco Aircraft Corp., will be used by the U.S. Air Force for testing the guidance system for the Boeing *Bomarc* guided missile. The bomber's nose is replaced by a 17-ft. *Bomarc* missile point.

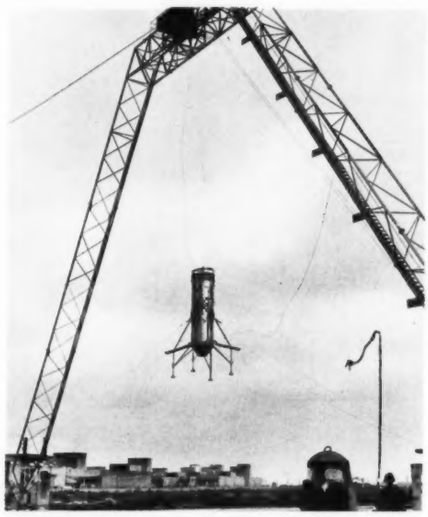
Fouga CM.171 *Makalu*, a flying test bed for the testing of the Turboméca *Gabizo* jet engine.

TECHNICAL

● The *Atar Volant* test vehicle (Flying Atar, a preliminary stage for a manned or unmanned VTOL aircraft) is now making free flight tests in a special safety rig. It is remote-controlled from a special command truck (equipment by Etablissements Jean Turck).—The first C 400 P1 test vehicle, shown here, will be followed by a piloted model, the C 400 P2, with light-weight ejection seat by Ouest Aviation. First free flight tests by the C 400 P2 are scheduled for the early months of this year.

Both the P1 and the P2 vehicles are fitted with an ATAR D jet engine. Versions with more powerful engines have been planned. The projected P3 model is to be built as a coleopter (with annular wing). This subsonic version will be followed by the first prototype of an experimental supersonic aircraft, powered by a turbojet with afterburner plus ramjet.





The *Flying ATAR* (C 400 P1), developed by France's S.N.E.C.M.A., has made free-flight tests inside a 115-ft. safety rig. The test vehicle is to be regarded as a forerunner to a line of vertical take-off aircraft. The safety cables connecting the *Flying ATAR* to the rig will be removed for later tests.

Short SC.1 experimental VTOL aircraft with five Rolls-Royce RB.108 turbojets.

● *A third SE.210 Caravelle* left the Sud-Est Aviation shops at the end of last year and is now undergoing extensive fatigue tests. Using a specially erected water tank, all airframe stresses arising during a one-hour's flight will be simulated within 4 minutes.—Another SE.210 aircraft will then be submitted to a conventional rupture test.

● *The Nord 2501 Noratlas* twin-engine transport can carry almost all its own spares, including outer wings, tail booms and front fuselage section with cockpit. Tail surfaces, tail booms and undercarriage can be carried in the cargo compartment, together with the dismantled outer wing.

● The *SO.9050 Trident II* interceptor, of Ouest Aviation, reached an altitude of more than 60,000 ft. and exceeded a speed of Mach 1.8 during a recent test flight.

● The projected *Bristol 194 helicopter*, to be fitted with two Napier *Gazelle* gas turbines, will reportedly have a gross weight of 20,000 lbs. and a cruising speed of approx. 160 m.p.h. The cabin will accommodate 21 passengers.

● *Short SC.1* is the type designation of the first British aircraft designed for vertical take-off and landing combined with cruising in normal attitude. It is powered by five Rolls-Royce RB.108 jets (see picture), four of which are used to supply the required lifting power for vertical take-off (or landing), while the fifth delivers thrust for normal forward flight. Stabilization during vertical flight is probably ensured by the ejection of compressed air at the fuselage nose and rear and on either side beneath the delta wing.

● The first *long-range Britannia 312*, for B.O.A.C., has begun flight testing at Bristol's Filton airfield. Four Bristol *Proteus 755* turboprops of 4,120 e.s.h.p. each are fitted.

● The *C-130 turboprop transport* seems likely to have a long career. Lockheed representatives announce that, in addition to the C-130A—already in production—and its successor the C-130B, at least five other versions of the *Hercules* are planned. They include a tanker-transport version, a naval patrol and long-range reconnaissance version and a version with combined wheel-and-ski undercarriage for Arctic operations.

● Flight testing of the *Convair F-106A* all-weather interceptor has begun at Edwards AFB, California. Power plant: one P & W J-75.

● The *de Havilland Canada DHC-4* project for a twin-engine transport aircraft bears the designation *Caribou*. Take-off and landing run will be about 500 ft., and the military version will carry 28 men, or two jeeps, or a 105-mm howitzer. Initially the aircraft will be fitted with Pratt & Whitney piston engines of a proved type, but turboprops are planned for a later version.

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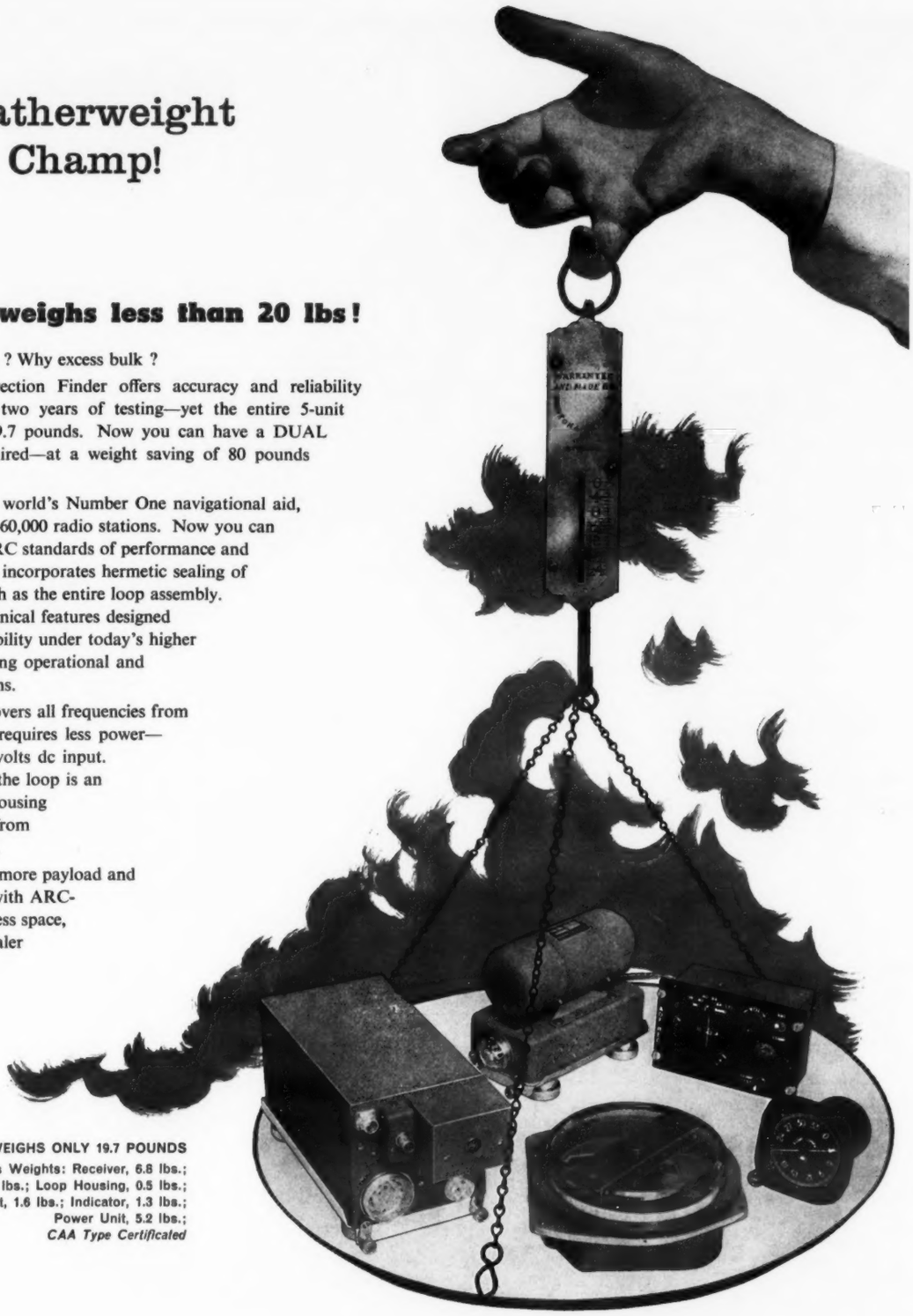

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The Armstrong Whitworth 650 Freightliner

The design of the type 650 freighter/transport, of *Sir W. G. Armstrong Whitworth Aircraft Ltd.*, incorporates many features suggested by extensive market research and was planned so as to ensure the widest possible field of application to civil freighting, air coach travel and military transport. In addition, great efforts have been made to ensure that the aircraft should incorporate the latest British power plant and accessory developments.

Accessibility to the freight hold has been a prime factor in the design, and forward and aft loading has been provided to give access to a wide, level and unobstructed floor. Since passengers are often vital to the integrated traffic pattern of an aircraft operator with all-freight services, the convertibility of the aircraft to the mixed passenger/cargo or purely passenger carrying role has been carefully considered.

A floor width sufficient to provide ample space for six-abreast seating on tourist coach services enables over 80 passengers to be carried if required. High density loads can be carried at low cost on stages up to 2,300 statute miles, and a characteristic feature of the work potential of the aircraft is the short range payload which reaches 2,800 lbs. (or 37 % of the initial design gross weight of 76,000 lbs.).

Fundamental to the design philosophy behind the twin-boom layout with " free fuselage " on the double-ended freighter coach is the provision of choice in power plant and fuselage length, which enables the prospective civil or military operator to select the optimum payload and range characteristic to suit his needs. Power plant can consist of four Rolls-Royce *Dart RDa. 7* propeller turbines or (later) two R.-R. *Tyne* twin-spool engines. Two fuselage lengths giving hold capacities of approximately 3,000 and 3,700 cubic feet respectively are planned. Further, an unpressurized fuselage of exceptional width for car ferry use can also be provided.

Dimensions, weights and design performance are given in the accompanying tables. Interesting structural details include hydraulically operated *double slotted flaps*, *spring tabs* and tension-compensated cable-operated *flight controls*. The pressurization system is operated with three engine-driven cabin blowers at a maximum pressure differential of 5 ½ p.s.i.

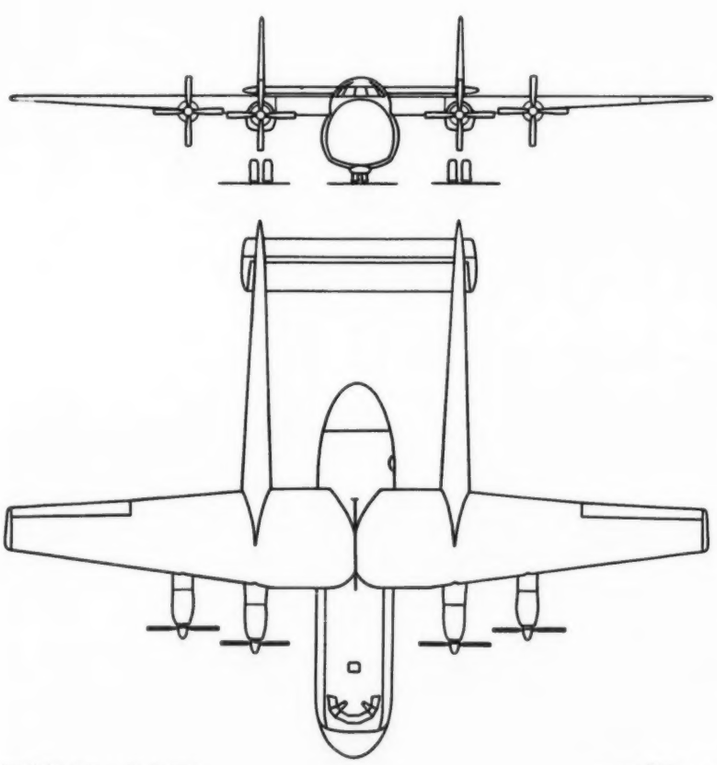
The retractable *tricycle undercarriage* has twin main and nose wheels. *Wingde-icing* is by hot air ducted from the power plant heat exchangers. Normally the aircraft will be operated by a crew of two or three, though the flight deck is laid out so as to provide space for extra or training crew, if required. A special study of visibility from the cockpit has been made, and the view provided is excellent.

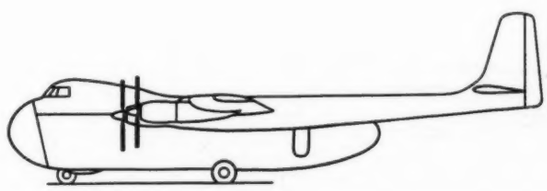
The two *freight doors* are 8 ft. 4 ins. (forward) and 8 ft. 8 ins. (rear) wide and 6 ft. 8 ins. high. Both are single doors, pressurized in flight, and give full width access at the forward and aft ends of the hold.

In the tourist coach version, six-abreast seating can be readily installed, with either fixed or folding seats. A total of 71 seats at 38-in. pitch or 82 at 32-in.pitch can be provided, with ample toilet and galley facilities for moderate stages. The passenger access door is on the port side forward of the rear freight door.

*

Initially ten *Freightliners* are to be built. The prototype, which is expected to be ready for flight testing before the end of 1958, will be fitted with Rolls-Royce *Dart RDa. 7/2* engines. It will be used for extensive test and demonstration flights. Full certification to British and U.S. standards is to be sought, and tropical trials will be conducted at a later stage of flight development.





Data for the AWA. 650 Freightliner

with four R.-R. **Dart 7** propeller turbines of 2,130 e.h.p. each; Rotol propellers of 11 ft. 6 ins. diameter.

Dimensions		**Weights**	
Span	115 ft.	Initial design gross weight	76,000 lbs.
Length	86 ft. 9 ins.	Development gross weight, at least	82,000 lbs.
Height	27 ft.		
Gross wing area	1,419 sq.ft.		
Aspect ratio	9.32		
Fuel capacity	3,300 Imp.gals.	**Freight hold:**	
		volume	3,680 cu.ft.
Design performance		floor area	426 sq.ft.
Take-off field length		length	47 ft.
(at 76,000 lbs.)	3,500 ft.	floor width	10 ft.
(at 82,000 lbs.)	4,200 ft.	minimum height	6 ft. 8 ins.
Mean cruising speed	296 m.p.h.	maximum height	8 ft. 9 ins.
Cruising altitude	25,000 ft.	floor level above ground	4 ft.

Payload-range characteristics

(still air and standard atmosphere conditions, and with reserves for 230 statute miles plus 45 minutes stand-off)

Payload for			
500 miles stage	28,000 lbs.	1,500 miles stage	22,000 lbs.
1,000 miles stage	26,500 lbs.	2,000 miles stage	17,500 lbs.

The Short PD.16 Project

Short Brothers & Harland Ltd., of Belfast, Northern Ireland, has also come out with a new design for a twin-engine cargo aircraft which can also be used for troop transport and passenger services. Designated the Short PD.16, it is designed in such a way that a wide variety of ranges and loads can be catered for by the use of different fuselages and tanks within the framework of the basic design. In the civil role the following missions are covered by the basic design :

1 — Transport of miscellaneous freight over short and medium ranges (see drawing below).

2 — Transport of passengers (up to 65) over short and medium ranges (see drawing below).

3 — When fitted with a fuselage having a lighter floor and no oversize freight doors, transport of light freight or passengers (up to 80) over short and medium ranges (see drawing p. 147).

4 — When fitted with a large unpressurized fuselage, transport of vehicles (up to 6) and passengers (32) over short ranges (see drawing p. 147).

The Short PD.16 is a high-wing monoplane with a single tailplane and twin fins carried from the wing on booms, on the forward ends of which are mounted two Bristol *Proteus 755* propeller turbine power units. It is envisaged these will be replaced during the development life of the aircraft by either Bristol BE. 25 *Orion*, Napier *Eland 4* or Rolls-Royce *Tyne* engines when these become available.

The basic fuselage design comprises a pressurized structure with a very strong floor, a flight deck above the forward part of the main hold and large doors at both front and rear for loading and unloading freight. Smaller passenger and crew doors are also fitted on either side of the fuselage. The fuselage is suspended from the wing by four fixing points.

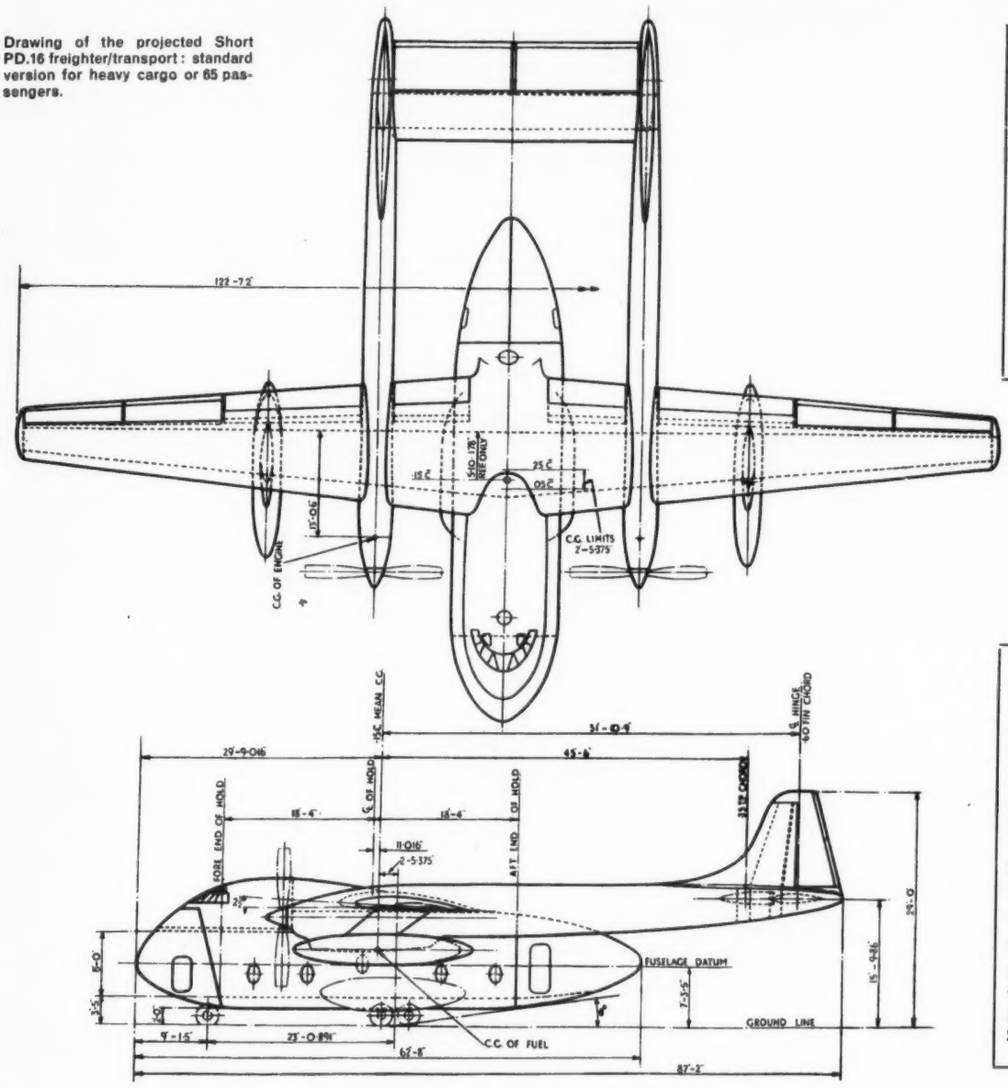
The undercarriage, consisting of five twin-wheel units with medium-pressure tyres, is laid out to permit take-off and landing on grass fields. It is fitted to and retracted into the fuselage. All the flying controls are manually operated by servo tabs. *The whole fuel supply is carried in two drop-shaped tanks suspended beneath the wing, the tanks being easily removed and replaced.* An auxiliary generating plant is provided for ground running, engine starting or emergency use in flight.

Built-in jacks at the forward end of the fuselage allow the nose-wheel to be retracted and the rear sill height to be adjusted to truck-bed height. Further jacks at the rear stabilize the fuselage for loading and unloading.

*

At the design all-up weight of 69,000 lbs., the makers give a take-off distance at sea level (to 50 ft.) as 685 yards in standard atmosphere and 845 yards in the tropics. The field length required to cover either an accelerate/stop or take-off with one engine cut is 1,040 yards (standard) or 1,300 yards (tropics).

The initial rate of climb in standard atmosphere conditions is 2,080 ft./min. Time to 20,000 ft. is 15.1 mins, and the 200 ft./min service



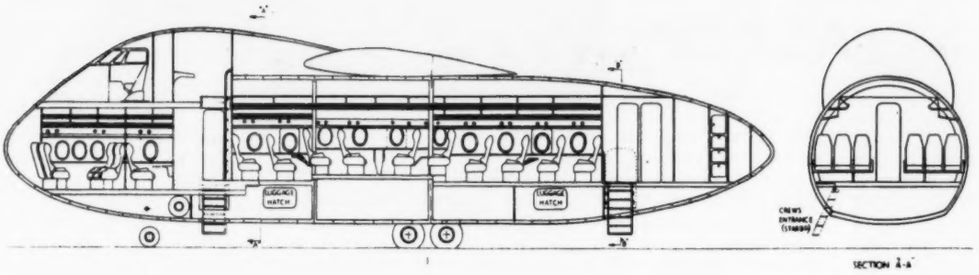
Drawing of the projected Short PD.16 freighter/transport : standard version for heavy cargo or 65 passengers.

DIMENSIONS

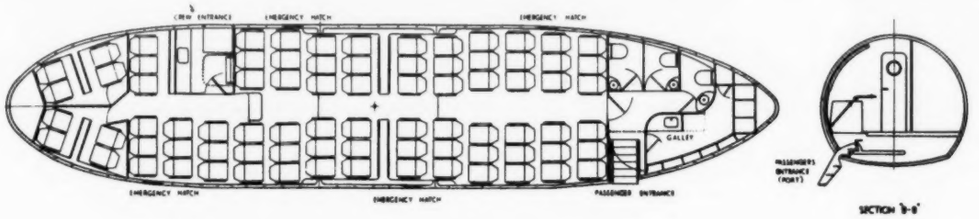
Span	122.6 ft.
Length	87.2 ft.
Height	29 ft.
Wing area	1,500 sq.ft.
Fuel capacity, normal	1,500 Imp.gals.
Fuel capacity, long range	2,250 Imp.gals.
Cargo compartment	
Floor area	338 sq.ft.
Max. internal width	12 ft.
Max. internal height	10 ft.
Undercarriage track	14 ft.

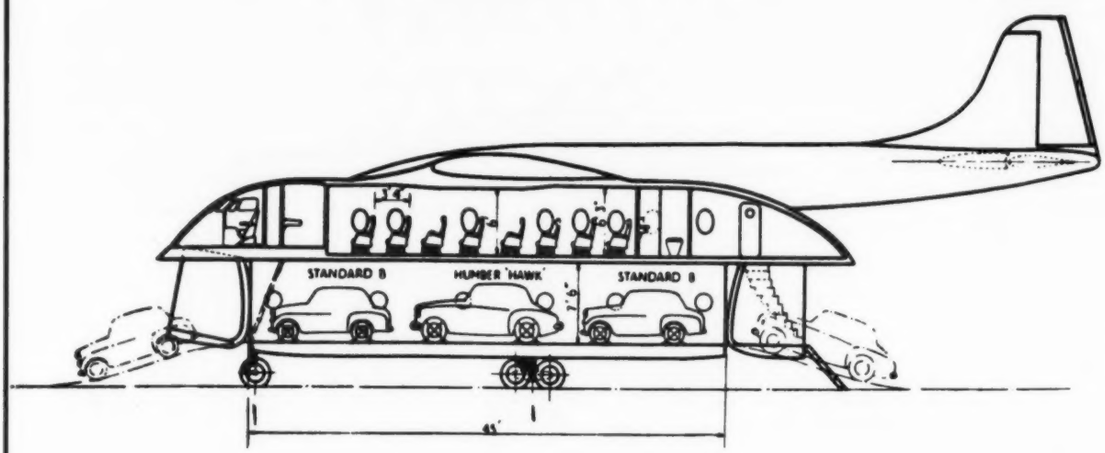
WEIGHTS

Max. gross weight (with **Proteus 755**)	69,000 lbs.
Max. gross weight (with BE.25) approx.	80,000 lbs.
Disposable load	27,360 lbs.
Structure	21,410 lbs.
Power plant (**Proteus 755**)	10,700 lbs.
Fuel and oil supply	1,560 lbs.
Other equipment	7,390 lbs.
Crew	580 lbs.
Operating weight empty (**Proteus 755**)	41,640 lbs.
Max. payload (with 2,360 lbs. fuel)	25,000 lbs.



In the version shown here—without oversize cargo doors front and rear and with lighter floor—the Short PD.16 can be used for pure passenger services - up to 80 passengers or for mixed passenger/freight services. The cabin is pressurized and air-conditioned.





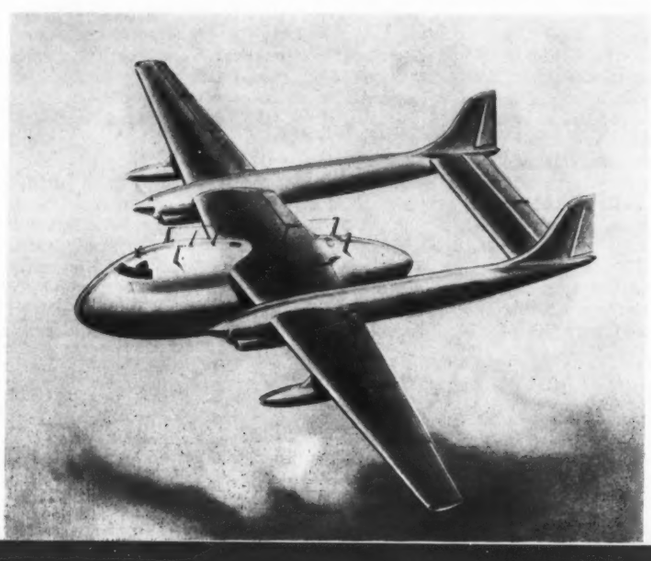
Drawing of a special version of the PD.16 for car ferry work, with larger, unpressurized fuselage: up to six vehicles (in two rows) and 32 passengers.

ceiling is 31,500 ft. The maximum continuous cruising speed is 310 m.p.h. at 20,000 ft.

The maximum payload of 25,000 lbs. can be carried over an equivalent still air range of 310 miles, and with full standard tanks (1,500 Imp. gals.) a payload of 15,200 lbs. can be carried over 1,980 miles. With long range tanks (2,250 Imp. gals.) a payload of 8,700 lbs. can be carried over 3,040 miles. Minimum direct operating cost is 9.2 pence (10.7 cents) per short-ton-mile and 1.3 pence (1.5 cents) per passenger-mile on a stage distance of 600 miles.

*

The Short PD.16—like its rival the A.W. 650—comes somewhere between the older range of freighter/transports, such as the Douglas *Dakota* (weight 28,000 lbs.), the Vickers *Valetta* (37,000 lbs.) and the Bristol *Freighter* (44,000 lbs.), and the new category of very much bigger transports such as the Lockheed C-130 A *Hercules* (124,500 lbs.) and the Blackburn *Beverley* (143,000 lbs.). As regards weight it corresponds roughly to the Fairchild C-119 (74,400 lbs.), which has been well proven in military operations.



Discussions with various civil operators suggest that the greatest present need is for a pressurized, turboprop-powered aircraft of between 55,000 and 75,000 lbs. all-up weight cruising as fast as possible. From these facts it appears right to design an aircraft of about half the size of the Lockheed *Hercules* having approximately the same performance. Such a machine would have a powerful appeal to civil operators and seems to represent a logical increase in size and performance over existing British types for military purposes.

The exact all-up weight of the aircraft would, of course, depend upon the choice of power plant. Turbojets are unsuitable because they do not allow sufficient flexibility of altitude in operation and because they are not economical at the range of speeds required. Turboprops, however, can be shown to cut down direct operating costs substantially, provided that the aircraft can operate at a reasonably high altitude (around 20,000 ft.). Furthermore, low operating costs are closely allied with high cruising speed, a strong factor of turboprops, and the experience of British European Airways with the Vickers *Viscount* has already shown what low maintenance costs can be achieved with this type of engine.

The performance required of an aircraft such as the Short PD. 16 can be summed up by the statement that it should be able to go anywhere that a Douglas *Dakota* can go and carry twice the payload at twice the speed.

AEROPLASTICS

BY LT. COL. FRANCO FIORIO, ROME

The aircraft industry of the Western world is looking today to plastics for the solution of many of its problems related to high temperature and corrosions encountered at high speeds, dielectric characteristics required by radio and radar radomes and several other critical fields. The present article therefore attempts to explore briefly the field of modern plastics which is creating a growing influence, both directly and indirectly, in the design and production of all modern aircraft.

*

The first phenolic laminates were adopted by the aircraft industry more than twenty years ago and, in the last fifteen years, acrylic laminates have been consistently used for windscreens and other transparent enclosures. Ten years ago, towards the end of World War II, the first reinforced laminates with polyesters and fibreglass were used in aircraft structures, and since then progress has been steady, both in quantity and quality.

It is well known that above 300°F (a temperature easily reached through aerodynamic friction by today's airplanes), the mechanical properties of aluminium and magnesium alloys deteriorate rapidly ; with further increased temperature (up to 500-600°F), the solution seems to be reinforced plastics, while for still higher temperatures titanium (800-900°F), stainless steel (over 900°F), superalloys and ceramics will have to be used.

Up to 500°F for continuous application and up to 1,000° for short periods of time, glass reinforced phenolic laminates have better rigidity than any metallic laminates of the same weight, while their shear and specific strength are somewhat lower : the improvement of these characteristics is the goal of current research and development study in the field of plastics.

Plastics in aircraft manufacture: the curved air duct in the Convair-Liner is made of Conolon; the soundproofing blankets are encased in vinyl.

Among other advantages in the use of plastics in the aircraft industry the following are of special significance : low production costs of the laminates ; easy repairs ; salt water and corrosion resistance ; possibility of forming intricate shapes ; fuel and lubricants resistance and, of particular importance, fatigue resistance.

Types of plastics used by the aircraft industry

Apart from a few exceptions, all the above types belong to the " reinforced laminated resins " family ; they can be divided into the following groups :

— phenolic laminates
— polyester laminates
— polyamidic laminates
— acrylic laminates
— laminates, silicone basis
— epoxy laminates.

The " reinforcement " types most commonly used are paper, cotton mat or fibre ; fibreglass, glass-mat, asbestos mat, nylon, orlon and dacron fabrics.

In general laminates employing phenolic, melamine and silicone resins are made on heated platen presses, under relatively high pressures, from 250 to 2,500 p.s.i. and temperatures from 270° to 350°F. The polyester and diallyl phtallate resin laminates are made on heated platen presses or on continuous laminators. The acrylic laminates are generally made on heated platen presses or by vacuum bag techniques. These are the so-called " low pressure " laminates because they are made at pressures of 250 p. s. i. or less.

The *phenolic laminates* have good thermoelastic properties and therefore are suitable for forming operations ; their high wear resistance makes them also ideal for brake lining and similar uses. Recent developments in phenolic resins have produced new laminates which are able to withstand temperatures of 400°F indefinitely and temperatures of 500-550°F for short periods of time.

The *polyester laminates*, developed only very recently, had a tremendous success in the aircraft industry for their low cost. Furthermore, the " wet laying " technique makes it possible to build polyester laminated parts in any shape, however intricate, with a high degree of structural strength and close tolerance. Typical examples are radio and radar radomes, aircraft armour and polyester laminated shields for fuel tank protection.

The *polyamidic laminates*, due to their high shock and wear resistance, are normally used, reinforced with nylon or dacron fabrics, to manufacture gears, pulleys and similar products.

The *acrylic laminates* are currently used in all kinds of transparent parts, with glass fibre, nylon, dacron or orlon as a reinforcing or filling component. The production of these laminates in the American aircraft industry has already reached a level of several thousand tons a year.

The *silicone laminates*, reinforced with fibreglass, are mostly used as insulating materials in the electrical systems of airplanes. Due to the very good resistance of these plastics up to temperatures of around 500°F, it is anticipated that, in the very near future, they will also be employed in structural parts of high temperatures.

The *epoxy laminates* are the newcomers to the family of aircraft plastics. Reinforced with fibreglass they are rapidly becoming a very important element in the manufacture of structural parts which are able to withstand high temperatures and severe corrosive environment.

Direct applications of plastics on aircraft

As already mentioned, the main application is perhaps for *windscreens*, *windows*, *canopies*, etc. The necessity for a very high shock resistance has been satisfied by the development of multiple laminates made of two rigid transparent laminated sheets held together by a flexible polyvinilic butyral filler. The type of laminated plastics to be adopted for the two rigid sheets is still today a matter of discussion. Some manufacturers prefer acrylic laminates, such as the " plexiglass series " or the " polymer K " produced by Röhm & Haas Co. ; others prefer polyester laminates such as the " Selection 44 " of Pittsburg Plate Glass Co. or the " Sierracin 611 " of Sierracin Corp.

Acrylics have about the same tensile strength as polyesters, i.e. 9,500 p.s.i. and a higher heat distortion point of about 200°F compared with 180°F for polyester. They are also easier to form since they can be drawn as much as 50 % or more, as compared with only about 10 % for the polyesters.

However, the polyesters do not seem to craze either from excess loading or from the majority of standard solvents, and the results of longtime weather tests show that after 9,000 hours polyester laminates carry a usable load of 2,000 p.s.i., while acrylic laminates are only capable of carrying 500 p.s.i.—a ratio of 4 to 1.

Both acrylic and polyester laminates cannot be bolted directly on to the aircraft structures due to their low resistance at concentrated loads. Therefore they have to be glued on to *contour frames* made of orlon or nylon reinforced plastic laminates which are nailed or bolted to the airplane structures.

Another large field for the application of reinforced plastic laminates is represented by the large family of radio and radar antenna *radomes* showing a steady increase in number and dimensions. Here the uniformity of material and the constancy of its physical and dielectrical characteristics are mandatory, with the added problem of reducing to a minimum the variations in characteristics in the temperature range from 70°F to 400°F.

Paper-based phenolic materials have been traditionally used in the manufacture of *terminal boards and other electrical parts*. However, electrical requirements have become more exacting, and production quantities have so increased that, for reasons of economy, parts machined from these paper-based materials have been replaced by parts moulded from a host of special purpose materials.

Laminates of epoxy, melamine, diallyl phtalate, and polyester resins combined with reinforcing fibres of glass, nylon, orlon, dacron and other fibrous materials are being used. The diallyl phtalate and epoxy laminates, with organic fibre reinforcement, are particularly interesting because they are readily machined and retain also high d-c resistivity under the most severe humidity.

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REVIEW OF WORLD AVIATION

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Materials containing organic fillers are unsatisfactory for radar and missile use because they are susceptible to fungus attack. Therefore today's trend in missile applications is toward the use of synthetic-fibre-filled materials for severe electrical requirements and of glass-fibre-filled materials when strength is the governing requirement.

With the increases in speed of modern aircraft, the heat resistance of the plastic components installed on the external surfaces of airplanes and missiles becomes the predominant parameter in the choice of the materials. Practically all existing plastic laminates lack somehow the required characteristics. Some glass-reinforced phenolic laminates represent an acceptable combination of heat resistance and mechanical rigidity up to 500°F. There are hopes of developing some silicone-base laminates with good characteristics up to 1,000°F.

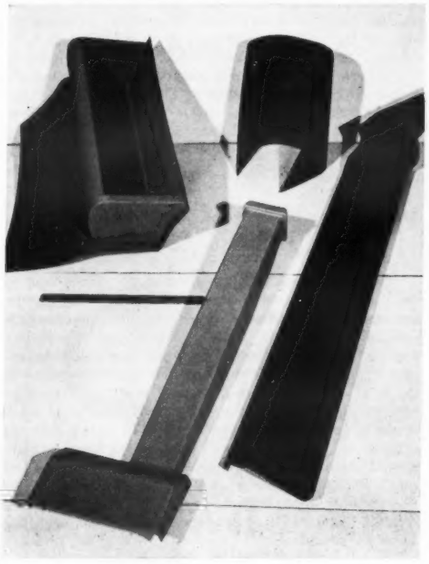
Still in the area of external plastic surfaces, one of the headaches is hail resistance. An American manufacturer has developed a core material and a skin impregnation system which absorbs the energy of a hailstone, instead of transmitting it through the plastic sandwich. A one-square-ft. panel of this construction has repeatedly withstood the impact of a 2-in. steel ball dropped 26 ft. Plastic radome sandwiches are also used in thousands of *radomes in gunfire systems* to absorb the shock waves.

The problem of rain erosion at high speeds on external plastic parts has been solved at present with *protective coatings* of neoprenes. However, neoprene coatings will not withstand temperatures exceeding 350°F for any length of time, and very active research is now underway to solve the problem. To date the most promising material seems to be lactoprene with special additions.

A very interesting application of plastics on aircraft is also the protection of self-sealing fuel tanks with *light shields* of glass reinforced polyester laminates to avoid the disturbance of the self-sealing process by metal splinters from nearby structures in case of bullet hits.

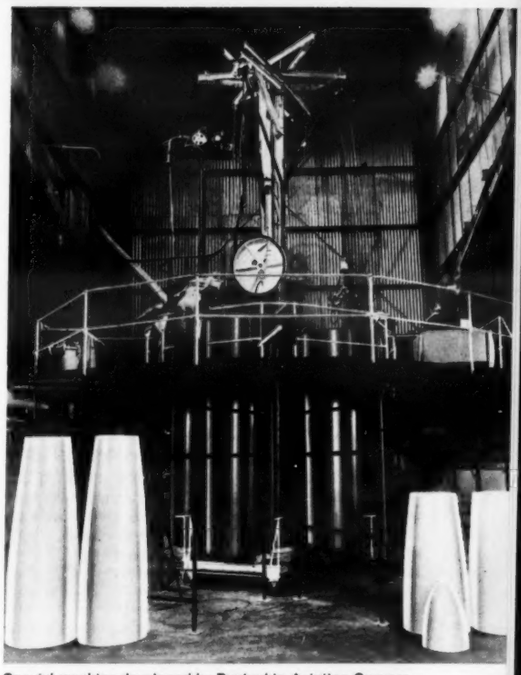
From these light types of protection to *plastic armour plates*, the step is very short. In fact, there are already in existence reinforced plastic armour plates capable of arresting subcalibre bullets and anti-aircraft shell splinters with weight savings of 75 % compared with steel plates of equal characteristics. In this particular field, however, the most impressive advantage of plastics over steels lies in the possibility of casting the plastic materials in any required shape or size without trouble, and of installing them in the vicinity of radio-electrical devices without creating magnetic field or electrical interference.

A selection of plastic fittings for the interior of an airliner.



The so-called " furnishing " items which have a special importance for commercial aircraft must be considered. Here copolymers are used in *lampshades, magazine racks, instrument panels, etc.* for their high tensile strength, ease of production and low specific weight ; butyrates in strips and extrusions due to their dimensional stability ; vinylic *fabrics* for draperies and wall coverings ; nylon, teflon, cellulose acetates for *discharge ducts, door seals, handles, etc.* ; phenolic laminates in *plastic sandwich structures.*

A rough estimate brings to 3.5 % of the empty weight the percentage of plastic materials on a modern airplane. Some American manufacturers are carrying out an even more ambitious development programme with the aim of building completely integrated plastic structures. Northrop-Radioplane is already producing a *plastic wing* for its XQ-10 drone. This wing is entirely built in glass reinforced polyester aminates enclosing a paper honeycomb structure. Aileron controls are in nylon and fibreglass. Another manufacturer, East Coast Aeronautics, has developed a plastic wing for the T-6 training plane. Several developments along these lines have shown attractive characteristics, weight saving, smoothness of external surfaces and very good fatigue resistance.



Special machine developed by Pastushin Aviation Corporation, Los Angeles, with six rotating cylinders. Each cylinder turns out one circular or oval hollow plastic part (if required, with integral stiffening) every ten minutes, by centrifugal action. Parts thus produced include aircraft fuel tanks, missile body components and other containers. Max. parts length 10 ft., diameter 44 ins.

High temperature applications

One of the most important applications in this field is the manufacture of *compressor blades* in turbojets and turboprops. The Cincinnati Testing Laboratory has, for instance, developed a temperature resistant phenolic resin (CTL-91-LD) which, moulded in turbojet compressor blades, makes them more reliable in centrifugal loading and in fatigue resistance than the steel blades which they are expected to replace. It seems that successful runs have already been made in one jet engine by using, in the first six stages of the compressor, fibreglass reinforced plastic blades employing Cincinnati's phenolic binder. This use has taken the material into the 450-500°F range. Savings in weight would be about four-fifths of the equivalent steel blades, in addition to time saving (only one-third of the production time of equivalent steel blades) and obviously of money.

A promising field of application for heat resistant plastics is the production of *combustion chambers for rocket engines.* The reduction in weight that might be realized from the use of a plastic chamber is as attractive to the rocket designer as it is to the aircraft designer. Some experiments have already been carried out by the Piccatinny Arsenal of the U.S. Army with a JATO rocket entirely made of plastic materials, and the results were very encouraging. Unfortunately, there is still a long way to go in this area because of the lack of plastic laminates having the required characteristics. A reinforced plastic with the following specifications, according to rocket experts, would be eagerly sought :

— minimum yield at 600°F 70,000 p.s.i.
— minimum modulus of elasticity 4 × 10^6 p.s.i.
— non-porous at 1,600 p.s.i. hydraulic pressure
— thermal expansion as near to steel as possible.

Adding to these specifications the particular properties of low thermal conductivity of plastics, the prospective use of material having such a characteristic would appear to be unlimited.

Auxiliary applications of plastics in the aircraft industry

In this class all plastic tools, templates, dies, platforms, jigs and similar parts that play a main role in aircraft production have to be considered. The use of plastics is very helpful in solving specific logistic problems such as the shift of giant jigs from one production area to another. It would be an almost impossible task to move the production jigs of today's huge transports and bombers ; it becomes feasible with plastic jigs having a 5 to 1 advantage in weight over the metallic ones.

On the same basis, in the case of forming dies for large parts, it is always easier to handle a plastic die having a specific weight of 70 lbs per cubic ft. than kirksite dies at 432 lbs. per cubic ft. Plastic dies are also attractive for the aircraft designer, because they can easily be changed to follow design improvements. In this field the epoxy laminates are rapidly taking the place of the glass reinforced polyester and phenolic resins traditionally used ; the reason for this is to be found in superior anti-shrinking characteristics, better adhesion to the glass fibres and easier handling of the epoxy laminates confronted with the polyester and phenolic laminates, all other factors being equal.

•

This summary on aeroplastics uses, although very sketchy and incomplete, has been written with the purpose of calling the attention of aircraft designers and manufacturers to the growing possibilities in the plastic field to the mutual advantage of both the aircraft and the plastic industries.

Book Reviews

Der Kunstflug.—By Hermann Zollinger.—Schweizer Druck- und Verlagshaus AG., Zurich, 1956 (German; 71 pages).

A course in aerobatics. This sub-title chosen by the author is a whole programme. This little book sets out to get converts to acrobatic flying. A first chapter of introductory hints and advice is followed by the first lesson in aerobatics, and a bare twenty pages later the reader has already become acquainted with 39 acrobatic figures. Finally comes the last hurdle, the rules for aerobatic licences. Good luck and success to all those who take the controls after reading this introduction. Re.

Grundfragen fliegerischer Ausbildung und Erziehung. — By Ernst Frowein.—Johann Ambrosius Barth, Munich, 1956 (German; 134 pages; price DM 13.50).

An internationally known glider pilot and head of the Institut für Segelflugforschung (Glider Research Institute) in Freiburg, the author here draws on his own experience of training questions. He sees the instructor's task as one of not only technical but also character training. Pointing out the importance of psychophysiology and psychotechnical considerations in flying training in the United States, he maintains that the problems of the relationship between man and machine necessitate an early weeding out among aircrew candidates.

Using gliding as a basis, he describes the fundamentals of a training method based on the assumption that the student's character and psychological aptitudes have a considerable influence on his flying ability. Frowein's own extensive investigations enable him to present a systematic picture of the relationship between efficiency and flight safety.—The ideas expressed here form a fitting supplement to S. J. Gerathewohl's " Die Psychologie des Menschen im Flugzeug " (from the same publishers), which was reviewed in *Interavia* No. 3, 1954, and could form the basis of a new concept in the training of German pilots. Re.

Geschichte eines Jagdgeschwaders.—By Josef Priller and others. Edited by Hans Otto Boehm.—Kurt Vowinckel, Heidelberg, 1956 (German; 404 pages; more than 100 photographs and drawings; price DM 22.50).

The World War II story of German Fighter Wing No. 26—which operated chiefly in the English Channel area—written by its commander Colonel J. Priller, with the assistance of several other members and opponents (British fighter pilots) of the wing. The fact that the authors include former enemies shows that this book is not written in boastful mood, but is intended as a serious, objective account. He.

Dans le vent des hélices. — By Didier Daurat, Editions du Seuil, Paris, 1956 (French, 232 pages, 16 pages of photographs).

The opening of the air route to South America will probably remain in the memory of Frenchmen as one of the great epics of the twentieth century. The event has been the subject of numerous books extolling, most of them in lyrical terms, the virtues of the pioneers who " cleared sand, mountains, sea and night ". The latest book in this field is by a man who was ultimately responsible, from numerous points of view, for the accomplishment of an ambitious design, the establishment of the longest route network in the world. These memoires had been long awaited, not only for the overall picture they would provide of a many-sided venture, but also (and with some curiosity) because they would enable a comparison to be made between Rivière in Saint-Exupéry's " Night Flight " and the man believed to have been his model. Admittedly Monsieur Daurat insists : " I am not Rivière ", but in the course of his recollections he frequently hints at a philosophy of discipline which recalls the shade of ruthlessness characteristic of Rivière, a ruthlessness which is justified not only by the results obtained but also in a remark such as " ... it is always and in all circumstances possibles to create a code of ethics which ennobles those who apply it ". This book, written to spur the young to greater efforts, ends with a statement of faith in man's superiority over the machine : " The pilot can never become a robot."

La.

Journalist in de Lucht. — By Hugo Hooftman; in the series " Aventuur en Ontdekking ". — Published by " De Kern ", Amsterdam, 1956 (Dutch, 176 pages, 23 photographs, price Fl. 4.25).

To dismiss Hooftman as a " Flying Dutchman " would be doing less than justice to this flying enthusiast, who spends his time climbing from one aircraft into another. Joking apart, the rate at which the author switches from a luxury flight by *Comet* to Rome to a buffeting freight flight by *Dakota* to Lapland, from a pressurized Convair 340 to a glider, from a police helicopter to a 25-day round-the-world trip ... is not only breath-taking but unbelievable. Sahara, Madeira, Christmas over Indonesia, by Silver City car ferry across the Channel; interviews with Igor Sikorsky, Stanley Hiller; cloud flights, engine runs, crystal-clear evenings in Africa ... Judging by his photograph, Hugo Hooftman must be still in his twenties or at most his early thirties. What will be left to him by 1970? A flight to the moon and back? He.

Starten und Fliegen. — Jahrbuch der Luftfahrt und Flugtechnik. Vol. I, 1956 (edited by Eitel-Friedrich Gebauer). — Deutsche Verlags-Anstalt, Stuttgart, 1956 (German, 392 pages).

The word " yearbook " used to describe " Starten und Fliegen " might be misunderstood if interpreted too literally. This is by no means a mere chronicle of aviation events in 1956, but a collection of popular contributions by qualified authors which—apparently following one another indiscriminately, but in fact arranged according to a definite plan—give an excellent picture of the many aspects of civil aviation today: research and development, air transport, ground organization, weather service, accident prevention, space travel, etc. The names of the contributors speak for the reliability of this book, which will undoubtedly make many a young man into an enthusiastic aviation fan. Representative authors include: Kyrill von Gersdorff (SNECMA) " How a Jet Engine Takes Shape "; Giuseppe Gabrielli (Manager, Fiat Aircraft Division) " From the Biplane to the Delta-Wing Aircraft "; Heinz Gartmann (rocket engineer) " Rocket Flight and Space Travel "; Siegfried J. Gerathewohl (School of Aviation Medicine, Randolph AFB, U.S.A.) " Who can become a Pilot ? ". — The publishers plan to issue a new volume in the series each year. It should be added that the photographic material is on the same high level as the articles. He.

Trident. By Charles Goujon. France-Empire, Paris, 1956 (French, 317 pages, 690 French francs).

The author, a test pilot who with Jacques Guignard has been engaged since 1952 in developing the fastest aircraft built in Europe, S.N.C.A.S.O.'s *Trident*, takes the reader behind the test flying scene, describing in lively fashion his anxieties and successes, disappointments and enthusiasms, and painting a comforting picture of the strength of a man willing to accept risks in order to bring engineering genius to triumph. So.

Le Bourget, une page d'histoire de l'aviation marchande. By Laurent Moutany. Club du beau livre, Paris (French, 171 pages).

This is a history not only of Le Bourget Airport but of the whole of French commercial aviation, written with faith and affection. So.

Sprechfunkverkehr mit Luftfahrzeugen. — By K. Möbius. — Vol. 3 In the series " Die Bücher der Luftfahrtpraxis ", edited by Dr. Ing. H. J. Zetzmann. Hanns Reich-Verlag, Munich 1956 (German-English; approx. 60 pages ; 7 illustrations; 3 special maps; sample flight plans; price DM 8.80.)

The logical and in all respects successful continuation to the second volume in the series (" Flugsicherung-Organisation und Betriebsverfahren ", by the same author; cf *Interavia* No. 9, 1956) will be a valuable textbook for the beginner and a welcome aid to those already engaged in air traffic control. A particularly praiseworthy feature is that the text is in two languages, with all air traffic control messages in both German and English. Use of the book is facilitated by the excellent list of contents at the head of each chapter and by an exhaustive subject index, again in both German and English. Na.

Luftfahrtdefinitionen (Glossary of Aeronautical Definitions). By Roderich Cescotti; Vol. 4 in the series " Die Bücher der Luftfahrtpraxis " edited by Dr. Ing. H. J. Zetzmann. Hanns Reich-Verlag, Munich, 1956 (German-English and English-German; 270 pages; 17 illustrations; price DM 13.80).

More than 3,500 terms, in German and English, make this little book an indispensable reference work for all persons of German mother tongue connected with aviation. In particular, I.C.A.O. and A.G.A.R.D. terms have been adapted to the German aviation language by competent experts, and the expressions used here have been recognized by the authorities as internationally valid. Two alphabetical subject indexes (English and German) provide for rapid reference. Na.

Physiologie du vol, hygiène de l'aviateur. — By Dr. E. Evrard. Office de Publicité S.A., Brussels, 1956 (French, 223 pages, 240 Belgian francs).

Written primarily for aircrews, this book is designed to acquaint civil and military flyers, the medical officers in charge of them, and design engineers with the principal biological and medical conditions of flying safety. In the choice of chapters and their contents, the author has followed the programmes prepared by the specialized international organizations as a minimum basis for the aero-medical instruction to be given to every pilot during and after his training. Without using any exaggeratedly technical vocabulary, it examines in detail the safety limits of the human organism in flight and the means of protection, in particular as regards altitude, acceleration and decompression of cabins. So.

Radio Telemetry. — By Myron H. Nichols and Lawrence L. Rauch. John Wiley & Sons, New York, and Chapman & Hall, London, 1956 (English, 461 pages, price $12.00).

This highly specialized book, written for a restricted group of readers, fills a gap in literature on radio telemetry and should be of valuable assistance in particular to engineers concerned with the flight testing of new aircraft and guided missiles. The three parts deal respectively with the methods, foundations and techniques of radio telemetering, based not only on original research by the two authors but also on hitherto secret or inaccessible U.S. Air Force research reports. Compared with the first edition, published in 1954 under U.S.A.F. contract as a volume in the " Air Research Series ", this second edition has been expanded by four chapters giving a detailed description of the latest telemetering, data reduction and remote control systems. Appendices totalling nearly a hundred pages give common formulae, telemetry standards for guided missiles, etc. and an extensive bibliography. Re.

Aéro-électrique. — Issued by A.E.R.A. ; Dunod, Paris, 1955 (French, XVI+846 pages, 7,500 French francs).

The present book is a collection of the papers read to the first international congress on aero electronics, the primary aim of which was to assemble aeronautical construction experts, missile users and electronics engineers for a discussion of the assistance which electronics has given to aviation and the problems which it can and should help to solve. The aircraft must be treated as a whole, and its operational value is often measured by that of its weakest link: in such a complex system, no detail can be neglected. The present book should therefore help all concerned with the design and manufacture of aircraft to a better understanding of the general framework into which their individual efforts fit and hence of the requirements they are called upon to meet. So.

La thermodynamique et le théorème de l'energie utilisable. — By R. Marchal. Dunod, Paris, 1956 (French, 218 pages, 1,580 French francs).

Written for engineers, this book reproduces the material used in a course of lectures at the *Ecole Supérieure du Génie Rural* and aims at presenting a clear picture of the functioning of prime movers, thermal and refrigerating machines. The author keeps down mathematical formulae to a minimum and concentrates his attention primarily on basic questions, with an extensive exposé of the theory of available energy. A chapter devoted to diagrams presents a general synthesis of the method. So.

L'Ecole nationale supérieure de l'aéronautique, 1956. — Librairie Vuibert, Paris, 1956 (French, 196 pages).

This booklet gives an outline of French teaching in the aeronautical field and of the history, charter, general organization and teaching of the *Ecole nationale supérieure de l'aéronautique*. A series of appendices, addressed in particular to students, provides the main details of the school, its staff, programme and rules, as well as the entrance examination and the admission conditions for foreign students. So.

Books received

Landbouwvliegtuigen (56 pages, 30 photos);

Zweefvliegtuigen (56 pages, 26 photos);

Both by Hugo Hooftman. — N.V. Uitgeverij " De Kern ", Amsterdam, 1956. Well-illustrated pocket booklets on agricultural aircraft and gliders respectively.

TRANSLATION

Wie ich Testpilot wurde —By Neville Duke. Translated from the English and arranged by Werner DeHaas. Title of the English original " Test Pilot ".—Albert Müller, Rüschlikon-Zurich, 1955 (German; 182 pages; price 13.30 Swiss francs or DM 12.80).

This book by the courageous British test pilot Neville Duke—who has just resigned as Chief Test Pilot of the Hawker Siddeley Group for health reasons—is more than an autobiography. It is the *credo* of all test pilots, a simple but penetrating accounting of the relationship between man and speed. Its translation into other languages is to be welcomed, since its message applies to the younger generation throughout the world. He.

Correction.

In the article on " The 7th International Astronautical Congress in Rome " (No. 12, 1956, p. 950) it was stated that *Dr. Ing. F. Romano* (Contraves Italiana) addressed the Congress on the possibilities of protecting artificial satellites from detection. It should be made clear that Dr. Romano is not a member of Contraves Italiana, but an Italian Army officer attached to the company to supervise production of Army equipment.

Editors.

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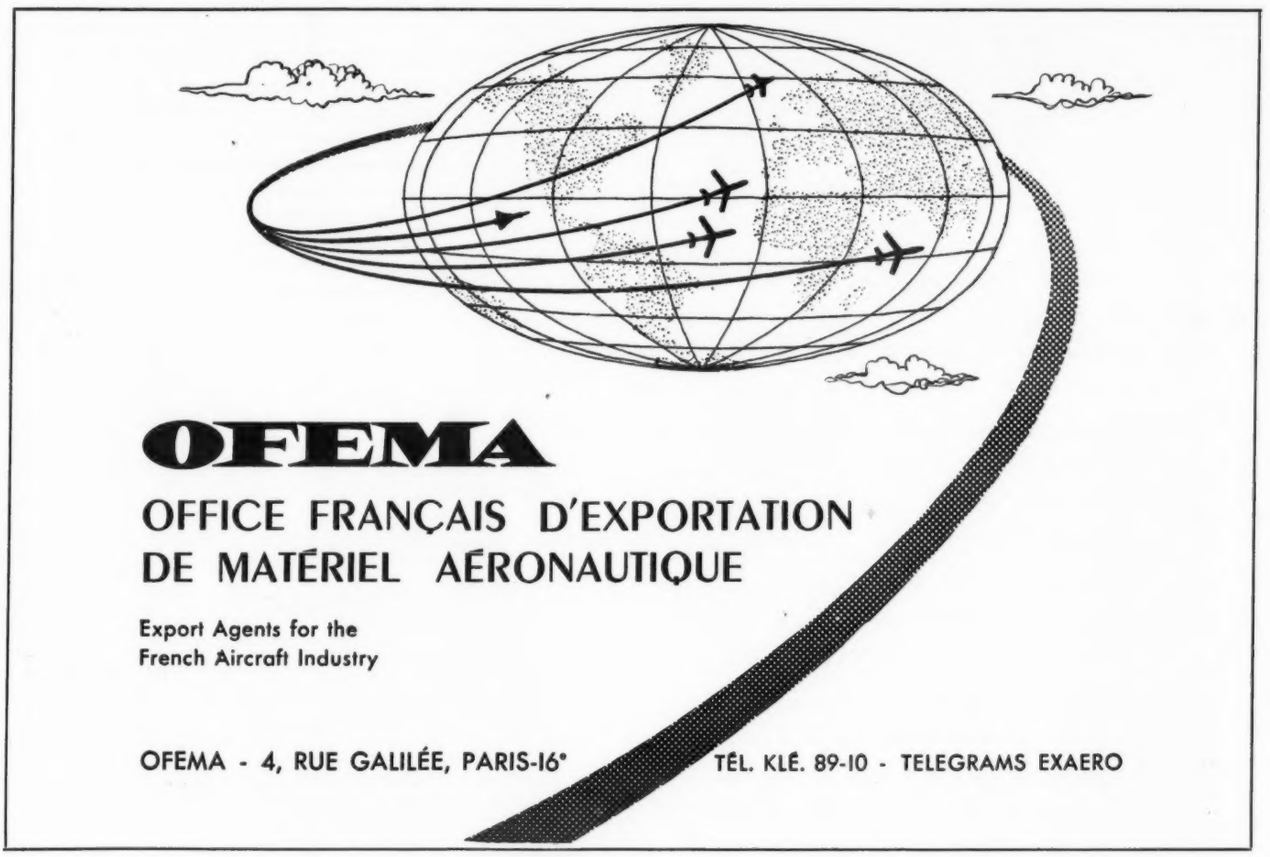

SUPPORT

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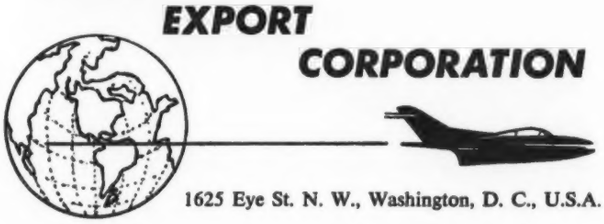

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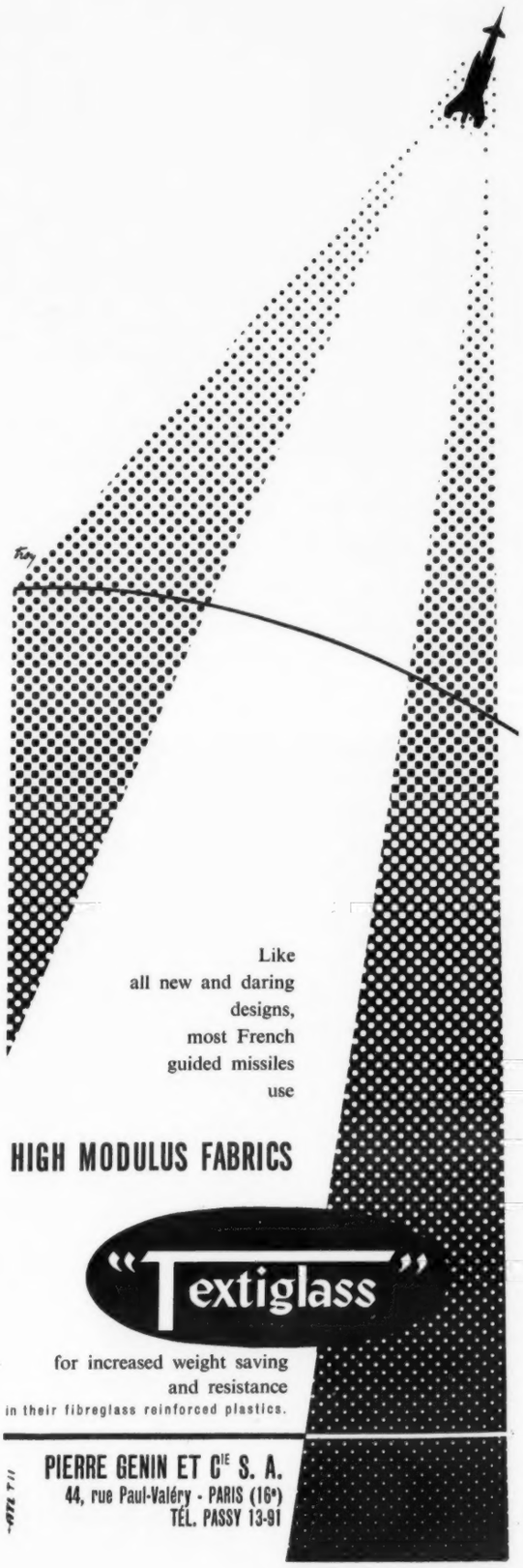

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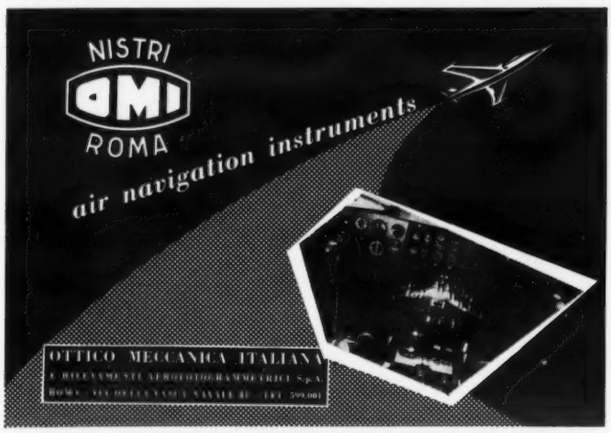

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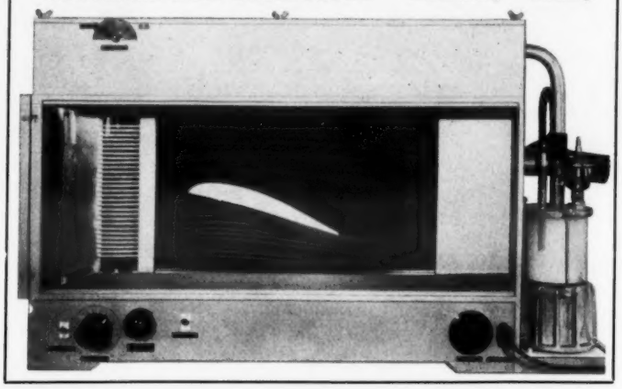

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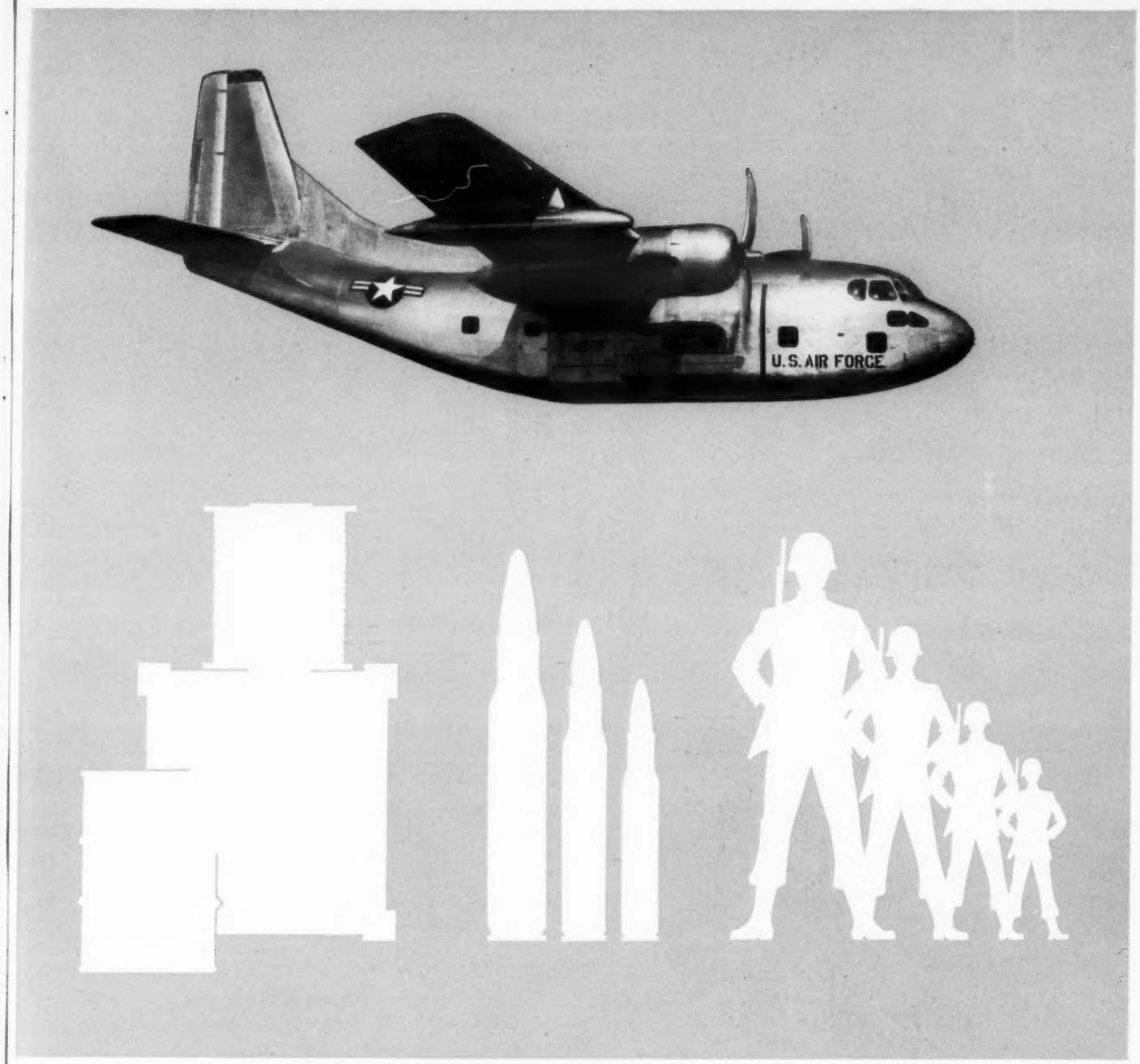

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